

Report No: 9060/2
Date: July 2006

**VERIFICATION REPORT
for the
REMEDIATION AND PREPARATORY WORKS
of land at
GOLDTHORPE COLLIERY,
GOLDTHORPE**

**prepared for
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Appendix B – Correspondence

From	To	Date	Content
CA	EC	17 TH May 2006	Permission to treat mine entries
EC	BMBC Highways	13 th April 2006	Road footprint proposals
BMBC Highways	EC	5 th April 2006	Response to letter 28 th March 2006
EC	BMBC Highways	28 th March 2006	CBR results of access road
EC	NHBC	7 th March 2006	Remedial Strategy cover letter
EC	BMBC Planning	7 th March 2006	Remedial Strategy cover letter
EC	BBH	5 th January 2005	Gas monitoring results

Appendix C – Geotechnical Testing Results

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1 INTRODUCTION

- 1.1 Remediation and ground preparatory works have been undertaken at Goldthorpe Colliery, Goldthorpe. The site had formerly been used as a colliery until its closure in 1994.
- 1.2 The site was investigated by Encia Consulting Limited (formerly AIG Consultants Ltd) as detailed in the following reports:
- Geoenvironmental Report for Goldthorpe Colliery, Goldthorpe; Report No. 2500/1, dated June 2002.
 - Addendum Geoenvironmental Report for Goldthorpe Colliery, Goldthorpe; Report No. 2500/2, dated June 2004.
 - Remediation Strategy for land at Goldthorpe Colliery, Goldthorpe; Report No. 9060/1, dated March 2005.
- 1.3 Earlier phases of ground investigation were undertaken by RPS Group and IMC, which are detailed in the following reports and summarised in the reports above.
- Goldthorpe Colliery, Level II Appraisal. *RPS Group Plc for British Coal Property.* October 1996.
 - Goldthorpe Colliery, Level III Site Investigation. *RPS Group Plc for British Coal Property.* October 1996.
 - Interim Report on the Proposed Reclamation of Goldthorpe Mine Site to "Soft-End" Use (Moynihan). *IMC Environmental Consultants for British Coal Property.* December 1996.
- 1.4 Copies of the Remediation Strategy (Report No. 9060/1) and the Geoenvironmental Report (Report No. 2500/1) were forwarded to Barnsley Metropolitan Borough Council (BMBC) and the National House Building Council (NHBC).
- 1.5 Copies of the correspondence pertaining to the issue of the above report are presented in Appendix B.
- 1.6 Encia Remediation Limited (ER) carried out remediation and preparatory works, in general accordance with the Remediation Strategy, on behalf of Ben Bailey Homes Ltd, between 3rd January 2006 and 7th July 2006, under the supervision of Encia Consulting Ltd (EC).

1.7 The purpose of this document is fourfold:

- To summarise the background to the works.
- To provide detail on the extent of all remediation and ground preparatory works undertaken.
- To describe additions and variations to works in the Remediation Strategy.
- To demonstrate and certify that the site is fit to form a suitable platform for residential development.

2 BACKGROUND

2.1 General

2.1.1 The site comprises the former main colliery and the former main colliery spoil tip areas. The main colliery area is under the ownership of Ben Bailey Homes Ltd (BBH) and is to be redeveloped with residential properties. The main colliery spoil tip area will remain in the ownership of Ogden Ltd.

2.1.2 The main colliery area is referred to herein as the 'development area' and the main colliery spoil tip as the 'main tip' area. Drawing No. 9060/008, presented in Appendix A shows these areas.

2.1.3 It is not the intention of this report to describe in detail the background to the site and reference should be made to the reports listed in Section 1.2; however, a summary of the salient points is provided as follows.

2.2 Site Location and features

2.2.1 The site is located at National Grid Reference SE 472 043 approximately 11km east of Barnsley town centre and occupies a total area of approximately 24 hectares.

2.2.2 A 1:25,000 Site Location Plan is presented in Appendix A as Drawing No. 9060/001.

2.2.3 Table 1 below summarises the surrounding land use of the site.

Table 1 - Summary of Surrounding Land Use

Boundary	Description of Land Use
North	Football pitch, Public park and open fields
East	Woods and open fields
South	Railway cutting and open fields beyond
West	Derelict land then Goldthorpe village

2.3 Site History

- 2.3.1 A summary of the salient points extracted from Ordnance Survey plans relating to the history of the site is presented in Table 2 below.

Table 2 – Summary of Site History

Year	Remarks
1851/54	The main site is shown to consist of several open fields. To the north of the site is an unnamed road (in line with the current Doncaster Road). The village of Goldthorpe lies approximately 250m to the south west of the site. Springs are denoted at the eastern boundary of the site
1892	Little alteration to the site with the exception of small areas of plantation and hedgerows.
1906/07	No significant changes occur to the site until 1906/07 when the LMS railway is shown to be under construction along the sites southern boundary. To the north, the cricket/football ground and allotment gardens are shown roughly in their current locations. To the west, terrace housing has been constructed along Beaver Street and Victoria Street.
1910	Shafts 1 and 2 of Goldthorpe Colliery were sunk. Construction of a small spoil tip to the west of the main colliery commenced during the late 1920's.
1930	Goldthorpe Colliery has been constructed and comprises a shaft, engine house and chimney along with several isolated buildings. The LMS Dearne Valley railway and its sidings are shown in the south of the site. A linear spoil heap lay to the north of the sidings and to the south of the shafts. The colliery offices, engine house, chimney and fitting shops lay to the north of the shafts.
1956	A large spoil tip is shown to the north of the railway in the west of the site.
1962	OS plans shows significant growth of the colliery with the addition of several buildings with rail/ tramways running between. A conveyor links the adit to the railway. The spoil tip in the west appears to have partially removed. Two sections of embankment have been constructed along northern boundary of the main colliery.
1988	By 1988, little significant alteration has occurred to the main colliery. The main spoil tip has developed and a section of West Moor Dyke appears to have been culverted.

2.4 Ground Conditions

- 2.4.1 The ground conditions encountered during the ground investigation within the development area are summarised below. Reference should be made to the reports listed in Sections 1.2 and 1.3 for a detailed description of the ground conditions.

Made Ground

- 2.4.2 Made ground was encountered across the whole site, typically less than 3.0m in thickness. The maximum depth of made ground encountered was in excess of 6.0m in the south east corner of the development area. Generally the made ground increases in thickness from north to south.
- 2.4.3 Generally the made ground was characterised as one of four types as follows:
- **Concrete/Tarmac:** Concrete covered approximately 60% of the site and varied from 0.1m to 0.45m in thickness. A thin layer of tarmac covered some areas of concrete roadways.
 - **Colliery Spoil – Coal:** A layer of coal generally comprising gravels of coal and carbonaceous mudstones was encountered in the north east of the development area. This layer was up to 1.0m in thickness and underlain by weathered sandstone.
 - **Colliery Spoil – Mixed:** A mixture of gravels and cobbles of mudstone, red shale, siltstone, and coal fragments. This type of made ground predominated over the whole of the development area.
 - **Colliery Spoil – Red Shale:** Found predominately in the south and south east of the development area and generally comprised gravels and cobbles of red shale and occasional gravels of mudstone.

Natural Ground

2.4.4 Natural ground was encountered in all of the exploratory holes with the exception of those within the extreme south east of the development area. Natural ground was described as follows:

- **Residual/weathered Middle Coal Measures** comprised firm to stiff mottled clay.
- **Middle Coal Measures** were characterised as a very weak, fissured mudstone.
- **Weathered Ackworth Rock** was identified as a probably dense, light brown or orange brown fine to coarse sand with varying proportions of angular sandstone gravel.
- **Ackworth Rock** comprised fractured, orange brown fine to coarse grained sandstone.

2.5 Summary of Contamination Identified

- 2.5.1 The ground investigation identified elevated levels of inorganic contamination; most notably arsenic, boron, selenium, copper, nickel and zinc within the made ground.
- 2.5.2 An area of localised organic contamination was identified within TP116 at a depth of 0.3m. This was described as a 'tarry' pocket within the made ground. Analysis showed that the TPH concentration associated with this 'tarry' pocket was 968mg/kg. This level exceeded a threshold of 500mg/kg based on professional judgement.
- 2.5.3 An additional area of organic contamination was identified outside of the development boundary within TP109. This was described as having a tarry odour; however, analysis showed the concentration of TPH did not exceed 500mg/kg.
- 2.5.4 The locations of TP109 and TP116 are shown on Drawing No. 9060/002 presented in Appendix A.
- 2.5.5 Calorific value determination of the made ground has shown that it is generally combustible.
- 2.5.6 Several samples of made ground yielded concentrations of soluble sulphate in excess of the guidance value of 500mg/l.
- 2.5.7 No elevated leachable contaminants were identified when compared with the maximum permissible concentrations as defined by the Water Supply (Water Quality) Regulations 1989.

3. OVERVIEW OF PREPARATORY AND REMEDIATION WORKS

3.1. Aims

3.1.1. The aims of the remediation works were:

- To provide a final ground surface free from chemical contamination and suitable for the proposed end use of the site i.e. residential development with garden areas.
- To provide a development platform to facilitate the subsequent construction of roads and installation of drainage and the construction of housing.
- To provide acceptable levels and gradients for adoptable roads, drainage systems and floor slab levels.
- To satisfy the requirements of the Local Planning Authority and the National House

Building Council (NHBC).

3.2. Scope of Works

- 3.2.1. The Remediation Strategy detailed the works necessary to enable residential development at the site, most notably:

Development Area

- Breaking out sub-surface structures to an acceptable level;
- Backfill of all resultant excavations;
- Re-grade of site levels to design criteria;
- Provision of a minimum 1,000mm thick cover layer of 'clean' soils in garden and landscaped areas where required (i.e. underlain by potentially combustible made ground);
- Supervision and validation of the works by a suitably qualified consultant.

Main Tip Area

- Re-profiling of the northern slope face of the main tip to design contours;
- Excavation of a dry pond to design contours to facilitate storm water drainage of the development area.

- 3.2.2. The remediation and preparatory works were carried out under the full time supervision of EC between 3rd January 2006 and 7th July 2006.

4. DETAILS OF REMEDIATION WORKS

4.1. Site Clearance

- 4.1.1. The development area required minimal site clearance, as it was generally covered with hardstand or sparse vegetation. Several trees and overgrown shrubs were removed from the site.

4.2. Breaking Out and Processing of Structures

- 4.2.1. All concrete hardstand was excavated, crushed to <125mm and stockpiled on site for later re-use.
- 4.2.2. All relict foundations visible at surface were then excavated to their full lateral extent and depth. The resultant excavations were surveyed if necessary and backfilled in layers and subjected to nominal compaction. Where an excavation was beneath a proposed road it was filled and compacted in accordance with Specification for Highway Works, series 600, Earthworks (SHW, Series 600).
- 4.2.3. The whole site was not subject to turnover (excavation and replacement of made ground to check for structures and undesirable material); however, areas were turned over where historic plans showed structures or buildings. The oversize materials (large concrete/masonry structures) generated by the excavation of below ground obstructions and or turnover were removed and crushed.
- 4.2.4. Where encountered cobbles and boulders of sandstone and mudstone within the made ground were removed and crushed; however, there is a possibility that some still remain.

4.3. Earthworks

- 4.3.1. The site was re-graded to contours as shown by the as built contour plan, Drawing No. 81539/REM/033 presented in Appendix A, to provide remediated levels. The remediated levels are generally 1m below proposed finished floor levels.
- 4.3.2. Earthworks were carried out under the full time supervision of a suitably qualified EC Engineer.

Development Area

- 4.3.3. All made ground within the northern section of the development area was excavated exposing natural weathered sandstone. The area of exposed natural strata is shown on Drawing No. 9060/003, presented in Appendix A.
- 4.3.4. All excavated made ground was inspected for visual or olfactory evidence of gross organic contamination, and then sorted to remove any unacceptable materials such as boulders, timber, metal etc in order to produce fill materials of a grading suitable to allow satisfactory compaction.
- 4.3.5. Earthworks required within the development area to achieve remediated levels. All surplus material was utilised in the re-profiling of the main tip. The majority of the surplus material was in the form of a noise bund running east west along the northern development boundary.
- 4.3.6. Prior to placement of any fill, the sub-grade was inspected for any soft spots or evidence of undesirable materials e.g. wood, metal or plastic.
- 4.3.7. All fill placed outside of road footprints was placed in layers and nominally compacted to prevent excessive settlement.

Main Tip Area

- 4.3.8. Prior to any works being carried out on the northern slope face of the main tip area it was necessary to remove 30,000m³ of previously placed material. A third party moved this material from a stockpile west of the development area prior to the commencement of the remediation works.
- 4.3.9. The northern slope face of the main tip was re-profiled by placing and compacting fill against (and maintaining a similar gradient to) the existing slope to achieve the design contours.
- 4.3.10. The main tip was re-profiled utilising the surplus material from the development area, material previously placed on the slope and also the arisings from the excavation of a dry pond to the north of the main tip.
- 4.3.11. Each layer of fill was benched a minimum 300mm into the existing slope face and placed to a maximum thickness of 300mm. Following placement; the fill was subjected to tracked compaction.
- 4.3.12. A slope stability assessment was carried out by EC (Letter Report Ref. 2500/Slope/001/RJH/rjh) and concluded that the designed slope achieved a FoS of 1.6 and is therefore safe.

4.4. Treatment of Organic Contamination

- 4.4.1. The ground investigation identified a localised area of organic contamination at a depth of 0.3m within TP116. The area was covered by concrete hardstand and review of the trial pit logs showed that the contamination (recorded as 'tarry' pockets) was at the interface of the underside of the concrete and the made ground.

- 4.4.2. Following removal of the concrete, the made ground was inspected; however, it did not display any visual or olfactory evidence of organic contamination.
- 4.4.3. A trial pit (TP201) was excavated in the exact location of TP116 down to natural strata and the arisings inspected. No visual or olfactory evidence of organic contamination was encountered. Six further trial pits (TP202 - TP207) were excavated around TP201 and the arisings were inspected; however, no evidence of organic contamination was detected.
- 4.4.4. A sample was obtained from each of the trial pits at a level (47.3maOD) coincident with that of the 'tarry' pocket recorded in the ground investigation.
- 4.4.5. The results of the sampling are summarised in Table 3.

Table 3 – Summary of TPH Analysis

Sample Reference	TPH with GRO, DRO and LRO Banding			
	C ₆ -C ₁₀ (mg/kg)	>C ₁₀ -C ₂₀ (mg/kg)	>C ₂₀ -C ₄₀ (mg/kg)	TPH (C ₆ -C ₄₀) (mg/kg)
TP201 1D	<10	77	276	361
TP202 1D	<10	35	213	251
TP203 1D	<10	95	296	401
TP204 1D	<10	64	521	585
TP205 1D	<10	44	196	240
TP206 1D	<10	21	131	152
TP207 1D	<10	65	294	359

- 4.4.6. All the samples, with the exception of TP204 1D, gave results less than the 500mg/kg threshold as adopted within the Remedial Strategy.
- 4.4.7. EC have derived in-house Tier 1 Assessment Criteria for a range of determinands in a range of end-use scenarios. The values calculated for Diesel Range Organics (TPH C₁₀-C₂₀) and Lubricating Range Organics (C₂₁-C₄₀) in a residential-with-gardens situation (below a 600mm clean cover) are 540mg/kg and 5,000mg/kg respectively. This assumes that the site is not sensitive in terms of its proximity to controlled waters.
- 4.4.8. The nearest watercourse is West Moor Dyke, which lies within the main tip area; however, it is in excess of 300m from TP204. The soils and rocks underlying the east of the site have been classified as *minor aquifers in accordance with the EA Policy and Practice for the Protection of Groundwater (1988)*. Furthermore, there are no known groundwater abstractions within a 1km radius. Given these factors the site can be considered as having a low sensitivity in terms of its proximity to controlled waters.
- 4.4.9. It is considered that the EC Tier 1 values are appropriate and as such the concentration of TPH detected poses no risk to human health or controlled waters.
- 4.4.10. Drawing No. 9060/004 showing the location of TP201 to TP207 is presented in Appendix A. Notes describing how EC's Tier 1 Assessment Criteria have been derived are presented in Appendix E. The laboratory results pertaining to the analysis are presented in Appendix D.

4.5 Treatment of Mine Entries

- 4.5.1 The ground investigation identified four known mine entries within the site. Two of these are located in the south of the development area and the remaining entries are located within the main tip area. A summary of information relating to the entries is detailed in Table 4.

Table 4 – Mine Entry Summary

Entry	Location	Depth and Diameter	Information
Goldthorpe 1 (CA Ref. 446404-001)	Development Area E446839 N404140	63.1m Depth 4.27m Dia.	Filled 1973 Capped on made ground 1977
Goldthorpe 2 (CA Ref. 446404-002)	Development Area E446885 N404127	66.7m Depth 3.66m Dia.	Filled 1973 Capped on made ground 1977
Bella Adit (CA Ref. 447404-001)	Main Tip Area E447322 N404160	Unknown Depth 3.7m x 4.9m	Backfilled to 420m in 1995 Capped and vented
Un-named Shaft 3 (CA Ref. 447404-002)	Main Tip Area	Unknown	Unknown

4.5.2 Shafts Goldthorpe 1 and 2 conflict with the location of Road 3 and will therefore require capping on competent rock (encountered at approximately 43.50maOD and 43.25maOD respectively). The location of these shafts is detailed on Drawing No. 9060/005, presented in Appendix A.

4.5.3 Detailed design of the shaft caps should be presented to The Coal Authority (CA), NHBC and BMBC for approval prior to the commencement of the capping works.

4.5.4 Permission to treat the mine entries has been obtained from CA (copy presented in Appendix B). The CA should be contacted prior to construction of the caps, as inspection may be required.

4.6 Preparation of Adoptable Road Footprints

4.6.1 Generally the formation level of roads within the north of the development area was within natural weathered sandstone. In this area the road footprint was excavated to 200mm below road formation level. A 200mm layer of crushed brick and concrete, which classified as a Class 6F2 material in accordance with the Specification for Highway Works, series 600, Earthworks (SHW, Series 600) was then placed to provide a weather resistant formation.

4.6.2 In areas underlain by deeper made ground i.e. roads within the south of the development area, the made ground was excavated to a level 1m below road formation level or natural strata (whichever was the highest). The base of the excavation was then proof rolled, inspected and any soft areas were excavated and replaced with suitable granular fill.

4.6.3 Levels within the road footprint were then raised up to 200mm below road formation level utilising a Class 2C material. A 200mm layer of Class 6F2 material was then placed to provide a weather resistant formation.

4.6.4 The Class 2C material was classified in accordance with the Specification for Highway Works, series 600, Earthworks. This material was placed and compacted to a method specification as follows; 200mm layers compacted with a minimum of 4 passes of a BW6 (2900kg-3600kg per m width of roll category roller).

4.6.5 A site trial was carried out to ensure that the Class 2C material was effectively compacted with the above method. The results of the site trial showed that the material could be compacted to a minimum of 95% of the laboratory derived maximum dry density and also to less than 5% air voids. Laboratory results pertaining to the site trial are presented in Appendix C(iii).

4.6.6 The proposed development access road runs along the line of the existing site access road. The existing road was constructed from reinforced concrete slabs underlain by an ash fill.

- 4.6.7 Plate bearing tests 1 to 3 were carried out along the development access road at a depth coincident with that of the proposed road formation level to confirm acceptability of the existing fill.
- 4.6.8 Following completion of the plate bearing tests the reinforced concrete slabs were removed to allow the roads and sewers Contractor to reduce the level to road formation and construct the new road to the agreed design.
- 4.6.9 Laboratory geotechnical results pertaining to the classification of the Class 6F2 and 2C materials are presented in Appendix C(i) and C(ii) respectively.
- 4.6.10 Plate bearing tests were carried out on the road at formation level at a maximum of 50m centres to confirm that a minimum CBR of 2% had been achieved. Table 4 summarises the CBR results.

Table 4 – Summary of Plate Bearing Test Results

Test No.	CBR (%)	Location	Material
1	31	Access Road	Existing ash fill
2	33	Access Road	Existing ash fill
3	34	Access Road	Existing ash fill
4	33	Road 3 20m ch	Crushed brick and concrete
5	42	Road 3 45m ch	Crushed brick and concrete
6	46	Road 3 70m ch	Crushed brick and concrete
7	30	Road 3 95m ch	Crushed brick and concrete
8	32	Road 3 120m ch	Crushed brick and concrete
9	29	Road 3 145m ch	Crushed brick and concrete
10	21	Road 3 190m ch	Crushed brick and concrete
11	23	Road 2 35m ch	Crushed brick and concrete
12	21	Road 14 35m ch	Crushed brick and concrete
13	25	Road 3 0m ch	Crushed brick and concrete
14	51	Road 3 215m ch	Crushed brick and concrete
15	150	Road 3 250m ch	Crushed brick and concrete
16	29	Road 3 285m ch	Crushed brick and concrete
17	41	Road 3 305m ch	Crushed brick and concrete
18	86	Road 3 335m ch	Crushed brick and concrete
19	45	Road 4 10m ch	Crushed brick and concrete
20	32	Road 5 40m ch	Crushed brick and concrete
21	27	Road 5 100m ch	Crushed brick and concrete
22	250	Road 6 40m ch	Crushed brick and concrete
23	19	Road 3 720m ch	Crushed brick and concrete
24	6	Road 3 700m ch	Crushed brick and concrete
25	77	Road 3 685m ch	Crushed brick and concrete
26	43	Road 13 15m ch	Crushed brick and concrete
27	21	Road 13 30m ch	Crushed brick and concrete
28	540	Road 3 650m ch	Crushed brick and concrete
29	130	Road 3 600m ch	Crushed brick and concrete
30	910	Road 3 540m ch	Crushed brick and concrete
31	71	Road 3 500m ch	Crushed brick and concrete
32	61	Road 3 460m ch	Crushed brick and concrete
33	120	Road 3 410m ch	Crushed brick and concrete
34	42	Road 3 385m ch	Crushed brick and concrete
35	19	Road 7 20m ch	Crushed brick and concrete
36	35	Road 7 50m ch	Crushed brick and concrete
37	75	Road 7 85m ch	Crushed brick and concrete
38	8	Road 8 20m ch	Crushed brick and concrete
39	75	Road 9 35m ch	Crushed brick and concrete
40	82	Road 8 60m ch	Crushed brick and concrete
41	66	Road 9 10m ch	Crushed brick and concrete
42	75	Road 11 25m ch	Crushed brick and concrete
43	260	Road 10 55m ch	Crushed brick and concrete
44	140	Road 10 15m ch	Crushed brick and concrete

- 4.6.11 Plate bearing test results and associated CBR calculations are presented in Appendix C(iv). The location of the plate bearing tests are detailed on Drawing No. 9060/006 presented in Appendix A.

4.7 Treatment of Japanese Knotweed

- 4.7.1 Two areas of Japanese Knotweed were identified along the eastern side of the site access road (generally outside the site boundary).
- 4.7.2 A specialist Contractor was employed to remove and treat the full extent of Japanese Knotweed and impacted soils from within the site boundary in accordance with published guidelines.
- 4.7.3 Following excavation, the Japanese Knotweed and impacted soils were placed in a deposition area within the public open space in thin layers and treated with a residual herbicide (Tordon 22K). This area was lined with Terram 1000 treated with Tordon 22K prior to deposition of the Japanese Knotweed. The deposition area was capped with Terram 1000, which was also treated with Tordon 22K followed by 1.0m of clean soils.
- 4.7.4 Rhizome barriers (Terram 1000 treated with Tordon 22K) were installed at the site boundary to prevent any potential for any off site Knotweed to re-grow back into site.
- 4.7.5 The locations of the areas of Japanese Knotweed are shown on Drawing No. 9060/007, presented in Appendix A. The locations of the Japanese Knotweed excavations, deposition area and the rhizome barrier are also detailed on this drawing.

5 RECOMMENDATIONS

5.1 Foundations

- 5.1.1 Generally strip foundations will be suitable within the north of the site and piling will be required within the south. Construction of the foundations should be in accordance with the detailed foundation schedule.
- 5.1.2 Ground conditions at the site generally comprise a variable cover of made ground over *firm and stiff clay or dense sand and gravel*, over Middle Coal Measures and Ackworth Rock bedrock.
- 5.1.3 Made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying strata of adequate bearing capacity. The clay and granular soils are considered to have a safe bearing capacity of at least 100kN/m².
- 5.1.4 The natural cohesive soils are of medium shrinkability and therefore a minimum founding depth of 900mm is recommended. For granular soils a minimum founding depth of 600mm is recommended.
- 5.1.5 Piled foundations should be taken down into natural strata of sufficiently high bearing capacity. It is recommended that piles be taken down into underlying bedrock, which was encountered at depths of between 1.2m and 10.5m during the investigation.
- 5.1.6 Sub-surface concrete in contact with the made ground should be Design Sulphate Class DS-2, with the site allocated an ACEC Classification of AC-2s. Concrete Mixes should be in accordance with that scheduled in Section 5.2.
- 5.1.7 It is recommended that where piles are required, advice should be sought from a specialist piling contractor.

5.2 Designated Concrete Mixes

- 5.2.1 The following designated mixes in accordance with BRE Special Digest SD1:2005 and BS 8500: Part1: 2002 will be suitable for use on this site.

Application	DS-2 conditions ACEC Class AC-2s
Unreinforced strip/trench fill footings	FND2
Reinforced strip/ trench fill footings (mesh reinforcement)	FND2
Reinforced strip/ trench fill footings (rebar etc)	FND2
Ground Beams	FND2

5.3 Soil Cover for Garden Areas

- 5.3.1 A 1,000mm thick layer of clean capping material is to be placed in all gardens and landscape areas with the exception of those within the area detailed on Drawing No. 9060/003, presented in Appendix A, where all potentially combustible made ground was removed.
- 5.3.2 Approximately 1,000m³ of site won subsoil was stockpiled by ER for placement by BBH on a plot-by-plot basis during the latter stages of the build programme.
- 5.3.3 Ten samples (sample refs. SS1-SS10) of the sub soil were analysed for the following determinands:
- pH, copper, nickel, zinc, boron (water-soluble), chromium, arsenic, mercury, selenium, cadmium, lead and water-soluble sulphate*
- 5.3.4 The results of the chemical analysis (presented in Appendix D) showed that the soil is suitable for use as clean cover.
- 5.3.5 It is a requirement of the Remedial Strategy that a suitably qualified consultant undertake independent chemical and thickness validation of any imported topsoil or sub soils. Sampling should be undertaken at a rate of 1 sample per 300m³ and tested for the following determinands:
- pH, copper, nickel, zinc, boron (water-soluble), chromium, arsenic, mercury, selenium, cadmium, lead and water-soluble sulphate and TPH.*
- 5.3.6 Any arisings containing made ground should not be re-used in garden areas to raise levels; however, it can be used in areas which are to receive a hard cover e.g. pavements and private drives.
- 5.3.7 As dug natural weathered sandstone arisings (i.e. arisings from the area not requiring capping) are likely be suitable for re-use within garden areas as clean cover. In such case the soils would still be subject to independent chemical validation, inline with above prior to re-use.

5.4 Gas Protection Measures

- 5.4.1 Gas monitoring was undertaken at the site over approximately 6 months as detailed in letter report ref. 2500/1/RLM, dated 5th January 2005, presented in Appendix B. The results of the gas monitoring have placed the site as Characteristic Situation 2. In this situation the gas protection measures outlined below will need to be incorporated within **all** plots.

- Well constructed suspended floor slab;

- 1200 gauge membrane incorporated in the slab and sealed with top hats around service entries. The membrane should be sealed to the manufacturers specification;
- Passively ventilated sub-space and wall cavities;
- Minimum penetration of floor slab by services and minimum number of confined spaces such as cupboards above the slab. Any confined spaces should be ventilated.

5.4.2 The passively ventilated sub-space should be of the following design:

- Minimum clear open void depth of 200mm;
- Cross ventilation on two opposite faces of the open void;
- Ventilation set at a minimum of 2652mm²/m run of wall.

5.5 Existing Services

- 5.5.1 A high voltage cable crosses the south west corner of the site in the vicinity of Plots 267 and 268. The exact location of the cable should be confirmed prior to undertaking any excavations in this area.
- 5.5.2 A combined sewer runs across the north west corner of the development area from existing houses on Pickhill's Avenue to the foot bridge over a railway cutting south of the development area.

6 CONCLUSIONS

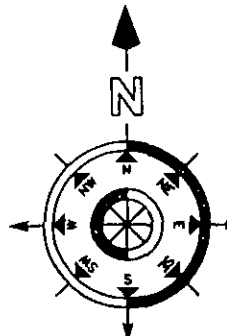
The remediation works agreed with Barnsley Metropolitan Borough Council and the National House Building Council have been carried out to date in accordance with Encia's 'Remedial Strategy for land at Goldthorpe Colliery, Goldthorpe' with variations as detailed in this report.

Goldthorpe 1
5.0m outside Diameter

ROAD NO.12

Goldthorpe 2
4.4m outside Diameter

ROAD NO.3

NOTES		
Goldthorpe 2 4.4m outside Diameter Mineshaft Location 		
REV.	DESCRIPTION	DATE

ENCIA
CONSULTING
LIMITED

ENCIA HOUSE, AUDBY LANE
WETHERBY, WEST YORKSHIRE
TEL: - 01937 589955 FAX: - 01937 589944

CLIENT

Ben Bailey
4 MMS LIMITED

Elizabeth House
Cliff Street, Mansborough
South Yorkshire, S64 6BQ
Tel: 01709 586281 Fax: 01709 570006

JOB TITLE

Goldthorpe Colliery,
Goldthorpe

DRAWING TITLE

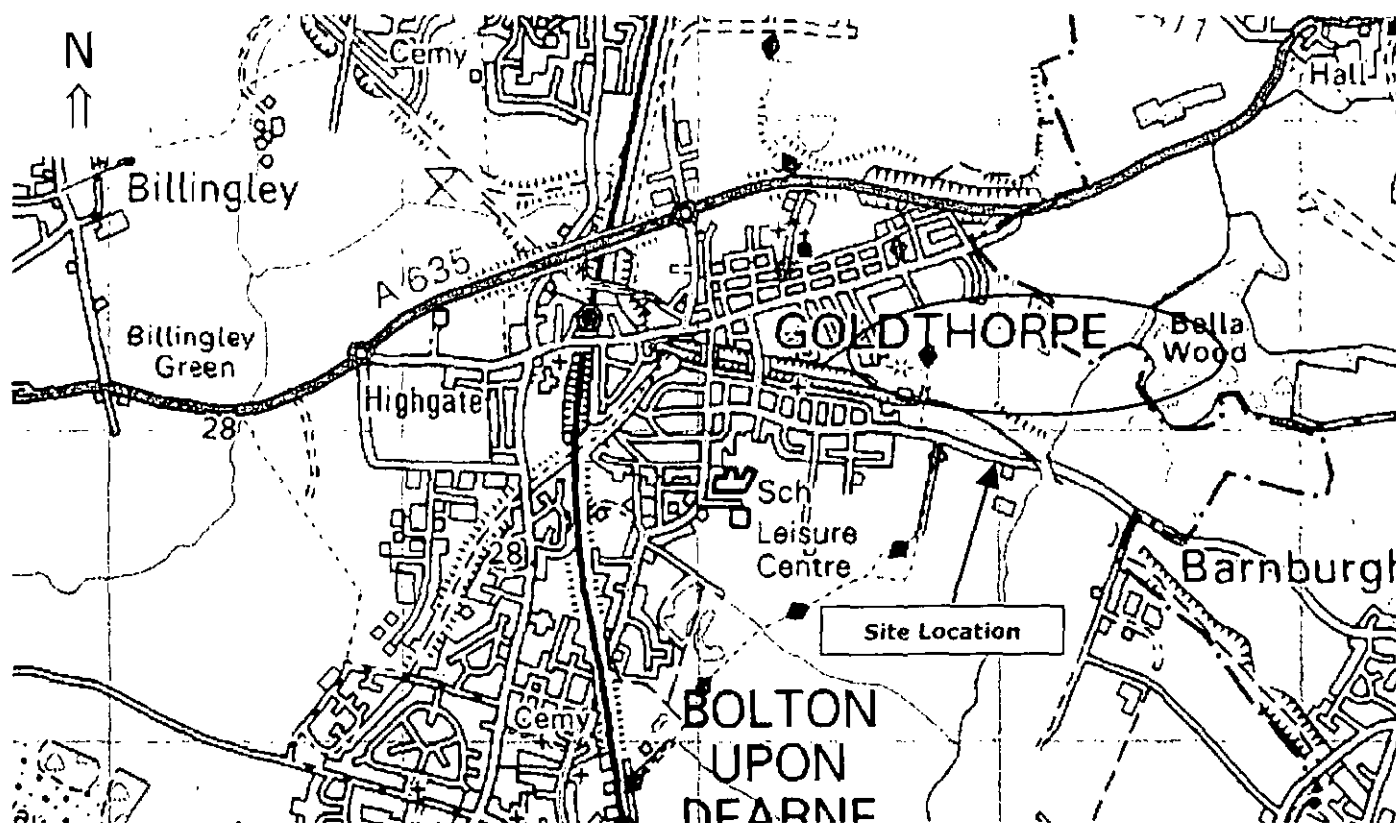
Mineshaft Locations

DRAWN	SIGNATURE	DATE	STATUS
MJC		19/07/06	FOR COMMENT ☐
APPROVED	SIGNATURE	DATE	FOR APPROVAL ☐
SRJ		19/07/06	DRAFT ☐
			FINAL ☒

SCALE	SHEET	DRAWING NO.	REVISION
1:250	A3	9060/005	

APPENDIX A

Drawings



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CLIENT

BEN BAILEY HOMES LIMITED

JOB TITLE

GOLDTHORPE COLLIERY, GOLDTHORPE

DRAWING TITLE

SITE LOCATION

DRAWN BY

MJC

SIGNATURE

DATE

JULY 06

STATUS

Final

APPROVED

SRJ

SIGNATURE

DATE

JULY 06

SCALE

1: 25,000

DRG NO.

9060/001

APPENDIX B
Correspondence

The
COAL
AUTHORITY



RECEIVED 18 MAY 2006

200 Lichfield Lane
Berry Hill
Mansfield
Nottinghamshire
NG18 4RG

Tel: 01623 638320
Fax: 01623 620363
E-mail: keithbanton@coal.gov.uk

Our Ref: 1813

17th May 2006

Encia Consulting Limited
Encia House
Audby Lane
Wetherby
LS22 7RD

For the attention of Matthew Cole

Dear Sir

Re-capping of Mineshafts 446404-001 & 446404-002 at Former Goldthorpe Colliery, Goldthorpe, Rotherham, South Yorkshire.

'Permission to Investigate and Treat Coal Mine Workings and Coal Mine Entries (Shafts & Adits)'

Thank you for your returned permission to investigate request. Payment of the £200 fee is acknowledged and attached to this letter is the counter-signed Permission to Treat document which, subject to the terms and conditions therein, allows you to carry out the works to the specification on the documents provided by yourselves.

However this permission is issued on the understanding that you will provide the Authority with the proposed specification for the treatment of these mine shafts, for comment, along with the results your investigations, prior to undertaking any re-capping work. You should not proceed with any treatment operations until we have either had the opportunity to visit site, or have confirmed in that it is acceptable for you to proceed.

I look forward to receiving your treatment specification and thereafter your completion report when the works are finished. In the meantime, should you wish to discuss this or any other matter, please do not hesitate to contact me. Would you also keep me informed of the planned timescale for this work in order that I may visit at a salient point.

Yours faithfully

Keith Banton
Indemnities Manager

Permission to Investigate & Treat Coal Mine Workings ("mine workings") and Coal Shafts & Adits ("mine entries")

Name and Address of Applicant ("the Applicant"):

Encia Consulting Limited
Encia House
Audby Lane
Wetherby
LS22 7RD

Site Description / Address:

Re Capping of Mineshafts 446404-001 & 446404-002 at
Former Goldthorpe Colliery
Goldthorpe
Rotherham
South Yorkshire

Terms and Conditions

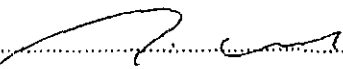
The Applicant must sign this document to signify acceptance of the terms and conditions set out below, and on the document being duly signed on behalf of the Coal Authority ("the Authority"), the Applicant will have the permission within the site boundary shown on the plan attached, to locate, investigate, and treat any disused mine entries or voids in or associated with shallow mine workings vested in the Authority to a depth of 50 metres from the surface. Permission to investigate and carry out treatment will cease 6 months after the effective date of this document.

- (1) The Applicant will take all steps, including the erection and maintenance of fences and warning notices, necessary to prevent any person from falling into or interfering with any mine entry, mine working, mining collapse, excavation or borehole.
- (2) The Applicant will ensure that nothing is deposited, falls or flows into any mine entry, mine working, mining collapse, excavation or borehole which by itself, or in combination with anything else which may be or which might reasonably be expected to be, in or adjacent to any such mine entry, mine working, mining collapse, excavation or borehole, could block or weaken any underground excavations beyond the area of investigation or treatment, or could cause or aggravate pollution of underground water, or could cause any nuisance or harm to persons or property on the surface or underground, including any mining operations.
- (3) The Applicant will ensure that testing procedures are adopted to detect the emission of any flammable or noxious gas from any part of the site, and take appropriate action to protect members of the public and workmen.
- (4) The Applicant will notify the Authority's Surface Hazards Office, using the 24 hour Emergency Call Out Service on 01623-646333, immediately there is evidence of spontaneous combustion, a gas emission or a discharge of minewater. The Applicant will, seeking proper advice if necessary, take all necessary steps for the purpose of controlling and extinguishing any spontaneous combustion or properly and safely dealing with any gas emission or discharge of minewater.
- (5) The Applicant will comply with all reasonable directions given by the Authority which the Authority in its absolute discretion believes is necessary to safeguard coal, mine workings, mine entries, the environment or public safety.
- (6) The Applicant will provide to the Authority and its representatives all necessary facilities at all reasonable times to inspect the site, and ensure that all permissions, consents and private or other rights are adequate to entitle the Authority or those authorised by it to gain access to the site for any purpose connected with the carrying out of its statutory duties, powers and obligations. The Applicant will notify the Authority's Licensing & Indemnities Office at least 48 hours prior to starting work on site and supply contact details of a nominated site supervisor.
- (7) Should it be found necessary, for whatever reason, to change the method of treatment, design or specification of the works from that contained in the application to the Authority, the prior permission of the Authority must be obtained before proceeding (such permission not to be unreasonably refused or delayed).
- (8) The Applicant will take account of the possibility of unrecorded mine workings and unrecorded disused mine entries within the site.
- (9) The Applicant will adopt appropriate practices and procedures for working and drilling in hazardous conditions associated with mine workings and mine entries and seek advice as may be necessary from suitably qualified persons.
- (10) Immediately on completion of each borehole it shall be temporarily plugged or sealed pending permanent sealing. Permanent sealing must be effected with sulphate resisting cement. Such permanent sealing to be throughout the borehole to full depth, and to take place as soon as practicable, having regard to the proposals for site stabilisation.

- (11) A written report by or on the behalf of the Applicant on the works carried out must be delivered to the Authority's Licensing & Indemnities Office at the address given above within one month of cessation of any phase of operations, or at any other date specified from time to time by the Authority. The report must include details of all excavations, gas and water encountered, treatment and stabilisation work carried out (including engineering drawings), plus drillers' logs and grout takes. Included in the report must be a plan to a scale of not less than 1/1250, referenced to Ordnance Survey National Grid, showing all boreholes and excavations, and the positions of mine entries and voids proved by the works, in relation to established surface features, and any surface development proposals.
- (12) At all times after the effective date of this Permission, the Applicant must indemnify the Authority against liability for claims, losses or damages, including claims by the Applicant, whether arising as a result of any failure by the Applicant or the Applicant's contractors, to comply with the requirements of this permission, or as a result of any act, failure, inadequacy, omission, negligence or default by the Applicant or the Applicant's contractors in designing or carrying out the work.
- (13) All costs incurred in compliance with this permission shall be borne by the Applicant.
- (14) For the avoidance of doubt, this permission does not confer upon the Applicant nor anyone acting on his behalf any right whatsoever to explore for coal, win and work coal, or to explore for coal mine or coal-bed methane. Where it is necessary to dig and carry away coal as part of the development, separate prior written permission must be sought from the Authority.
- (15) The Applicant will be responsible for obtaining any necessary permissions under the Town and Country Planning and any other relevant legislation, and for notifying statutory undertakers and other relevant bodies of his intentions, and for establishing the positions of any services on site.
- (16) The Applicant will obtain all necessary consents from surface and mineral owners, to obtain access to, and occupation of the site, and to carry out operations in any mine or mineral not vested in the Authority.
- (17) If at any time the Authority considers the Applicant to be in breach of any of the obligations or conditions of this document, the Authority may terminate this permission, with immediate effect, by oral or written notice.

If the terms and conditions given above are acceptable and permission is required, sign and date this document as indicated below and return to the address given above, including the requisite accompanying information outlined in the guidance notes and the appropriate fee. A site location plan to 1/1250 scale, referenced to Ordnance Survey National Grid, clearly identifying the site boundary in relation to established surface features must also be attached.

I agree to the terms and conditions set out in this permission:

Signed:  Date: 17/03/2006

(Please print clearly in Block Capital)

Name: R. J. HEY Telephone: 01937 589955

Position: REGIONAL DIRECTOR

For and on behalf of: ENCLIA CONSULTING LIMITED

Note that only when the document is subsequently reissued, duly signed on behalf of the Coal Authority is permission granted.

Signed:  Date: 17th May 2006 ("the effective date")

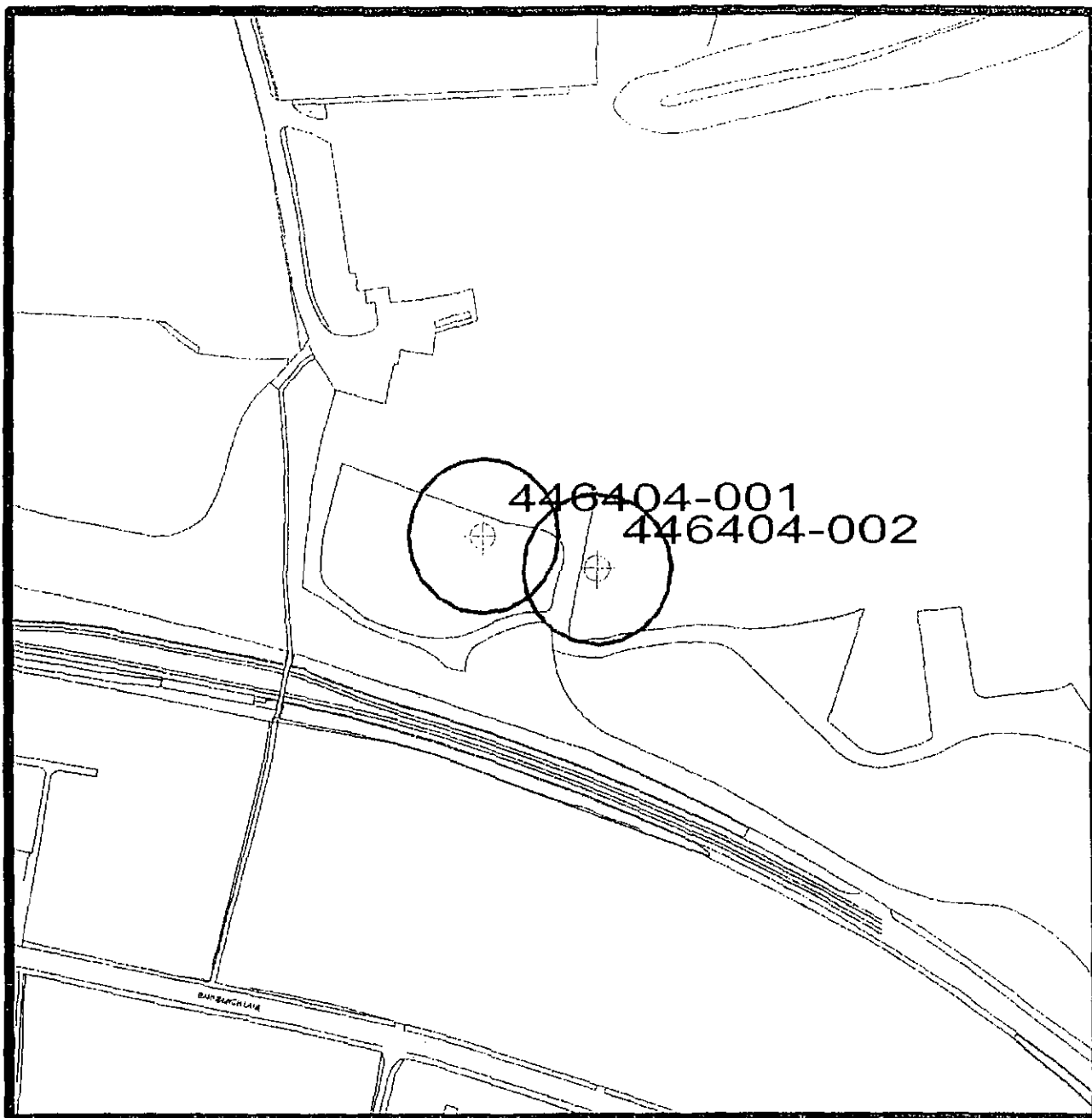
For and on behalf of The Director of Mining Projects/Property, the Coal Authority.

Nominated

Representative: Mr K. Barton, Indemnities Manager; telephone 01623 - 638320; e-mail permits@coal.gov.uk

Indemnity ref: 1813

Plan Referred To



Permission Boundary Shown :



Approximate Position Of Shaft Shown :



THE
COAL
AUTHORITY

Indemnity Ref : 1813

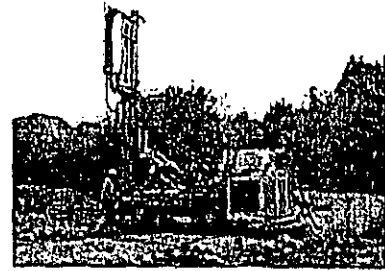
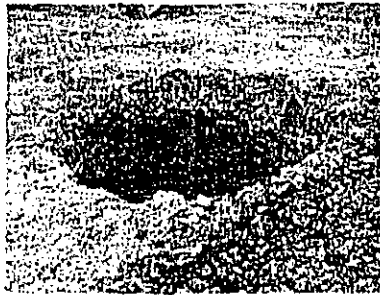
Mine entries within, or within 20 metres of the indicated site boundary are shown. However the records held by The Coal Authority may be incomplete. Consequently, there may exist in this locality mine entries of which we have no knowledge.

Scale : 1:2500

Crown Copyright. Quoted Scale is Approximate.

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The COAL AUTHORITY



GUIDANCE NOTES FOR PERMISSION TO ENTER OR DISTURB COAL AUTHORITY MINING INTERESTS

1. Introduction

Under the Coal Industry Act 1994 ownership of in situ coal, coal mines (both current and disused) and coal mine shafts & adits (previously vested in British Coal) transferred to the Coal Authority ("the Authority").

Any activities which intersect, disturb or enter any of the Authority's coal interests require the prior written permission of the Authority. *Failure to obtain such permission will result in trespass and the potential for court action.* Such activities include initial investigation and any subsequent treatment of coal mine workings and coal mine entries for ground stability purposes.

2. Information Required

To enable the Authority to consider the grant of any permission to enter or disturb coal or coal mine workings the Applicant must include the following information:-

- i. Name and address of Applicant i.e. person taking liability for the works.
- ii. Name, address and location of site.
- iii. Description of the proposed works including the method of investigation and method of treatment of any mine entries or mine working.
- iv. Proposed date of commencement and duration of works affecting Coal Authority interests.
- v. Details of measures the Applicant would take to prevent or remedy spontaneous combustion of coal (including details relating to the sealing of boreholes), uncontrolled emissions of mine gas or water or other hazard directly or indirectly caused or related by the proposed activities both during works and following completion of works.
- vi. A plan on a reasonable scale (to allow for digitisation on to the Authority's database), including salient surface features and preferably correlated to Ordnance Survey national grid.

The plan must include:-

- a. The limits of the site boundary
- b. The extent of mining related features to be investigated and/or treated, clearly delineated, if different to above.
- c. The nature and position of the proposed development in relation to the area to be treated.
- vii. Details & location, where known, of the coal mine workings and coal mine entries to be investigated. (Historic mining plans can be obtained from the Authority's Mining Records Office (01623 637 233 / 235), furthermore mining reports can be obtained from the Mining Reports Section (0845 7626849) or on line at www.coalminingreports.co.uk

3. Consideration of the Application

The Authority will process all applications having due regard to its statutory obligations; applicants should normally allow approximately **1 calendar month** for the processing of the application prior to the start any intrusive coal mining investigations, assuming all necessary information has been supplied and the requisite fee has been paid. Large or complex sites may require more time for the necessary background studies to be completed. The Applicant should respond promptly to any request for further information.

4. **Fees (From April 2006)**

Fees are based upon either the area of former mine workings or the number of mine entries to be investigated and/or treated.

- i. **£100 per 0.1 Hectare** (1000m²) or part thereof up to a maximum of £2500 (2.5 Hectares or above)
- ii. Investigation and/or treatment of **mine entries** (shafts and adits) only will be charged at **£100 per entry** up to a maximum of £2500 (25 shafts or more)
- iii. Applications can, in exceptional circumstances, be considered within 2 weeks but will be subject to an expediting fee of twice the normal applicable charge.
- iv. Retrospective applications will be considered provided all investigation and treatment works have been completed and recorded to accepted published standards. Retrospective applications will be punitively charged at twice normal applicable rate.
- v. In both the above scenarios (iii & iv) the maximum fee shall also be doubled.

5. **General**

Applicants should note the following in relation to their submissions:-

- i. The Authority reserves the right to require additional information and explanation from the Applicant.
- ii. The Authority may, from time to time, undertake site visits, to ensure adherence to the terms and conditions of the permit.
- iii. The Authority reserves the right to withhold permission should any information (including the requisite fee) which in the Authority's opinion is critical to the evaluation of the application, not be forthcoming from the Applicant.
- iv. In certain cases the Authority may require security for liabilities including but not limited to default on such items as treatment of shafts and adits and the grouting of former coal workings.
- v. The Authority may under certain circumstances require the Applicant to incorporate measures, within any remediation, to monitor or control mine gasses or water.

Applicants should note that former coal mine workings can contain both mine water and mine gas, sometimes under pressure. Drilling contractors should be competent and have the necessary experience to enter mine workings. Applicants should be conversant with all current applicable legislation and be familiar with and take account of the advice and references contained in publications relevant to the circumstances from authorities such as:

British Drilling Association (BDA) – Code of Safe Drilling Practice.

Construction Industry Research & Information Association (CIRIA) – Special Publication 32, Construction over Abandoned Mineworkings.

Department of the Environment - Planning Policy Guidance Notes – PPG 14 & Minerals Planning Guidance Notes – MPG 12.

On completion, selected technical details of the works carried out will be entered onto the Authority's database to reflect the work carried out and to ensure its availability to the public through the Authority's mining reports system.

It should be noted that the permission of the surface owner (if different from the Applicant), various regulatory authorities and other parties who have a legal interest may also be required.

Any coal encountered during site investigation works which is proposed to be dug and carried away from site will require a separate agreement which can be obtained by application to the Authority's Licensing Department. Furthermore activities which involve exploration for coal, the winning and working of coal, or the exploration for coal mine or coal-bed methane are also dealt with under separate documentation. Such activities may also require approval from regulatory bodies such as the Health and Safety Executive and Environment Agency.

Model documentation is available on the **Services / Licensing & Indemnities / Model Documents** section of the Authority's website www.coal.gov.uk. For queries regarding applications for permission to enter or disturb coal mining interests please contact the Licensing & Indemnities Office:-

Scotland; North East; Yorkshire; East Midlands – Keith Banton. Tel: 01623 637320 or keithbantton@coal.gov.uk

North West; West Midlands; Wales; South West – Terry Williams. Tel: 01623 637266 or terrywilliams@coal.gov.uk

General enquiries Tel 01623 637370 or 01623 637377

13th April 2006

Ms Karen Smith
Barnsley Metropolitan Borough Council
Central Offices
Kendray Street
Barnsley
S70 2TN



Please reply to:

☐ North West
Stone Cross Place,
Stone Cross Lane North, Lowton
WARRINGTON WA3 2SH
T 01942 824406 F 01942 824030

☒ Yorkshire
Encia House,
Audby Lane,
WETHERBY LS22 7RD
T 01937 589955 F 01937 589944

☐ North East
7 Eggleston Court,
Riverside Park,
MIDDLESBROUGH TS2 1RU
T 01642 809088 F 01642 809066

E info@enciagroup.co.uk W enciagroup.co.uk

Dear Karen,

Goldthorpe Colliery

Further to our recent telephone conversations I am writing to confirm the proposed method for the preparation of the roads within the development area of the above site.

For consideration of the ground conditions beneath proposed road footprints the site has been split into six phases. A phasing plan has been enclosed for your reference.

Phases 1,2 and 6

Generally the formation level of roads within phases 1, 2 and 6 is within the natural weathered sandstone strata, however in order to provide weather protection we propose to excavate to a depth of 200mm below road formation level and replace with a 200mm layer of crushed concrete.

Phases 3, 4 and 5

Generally the thickness of made ground within these areas is up to approximately 3-4m. Excavations carried out in these areas have shown that the made ground is largely inconsistent and would be difficult to characterise geotechnically.

It is proposed that made ground below road footprints will be excavated to 1.0m below road formation level and replaced with a consistent material. The proposed material is a mixed colliery spoil, which has been found to conform to a Class 2C material in accordance with the Specification for Highway Works, series 600, Earthworks.

This material will be placed to a method specification as follows; 200mm layers compacted with a *minimum of 4 passes of a BW6 (2900kg-3600kg per m width of roll category roller).*

A site trial has been carried out and has shown that the above method is appropriate, showing the material can be compacted to a minimum of 95% of the laboratory derived maximum dry density and also to less than 5% air voids.

Prior to the placement of the mixed colliery spoil the base of the excavation will be proof rolled and inspected and any soft materials will be excavated and replaced with suitable granular fill.

Plate bearing tests will be carried out on the road at formation level to confirm that a minimum CBR of 2% has been achieved; however the road pavement design will not be changed should the plate bearing tests yield a CBR greater than 2%. Usually we would undertake the plate bearing tests at 25m centres, however given that there is in excess of 1,000m of adoptable highways we propose to increase this to 50m.

Enclosed are copies of the laboratory geotechnical testing undertaken on the mixed colliery spoil, which are three particle size distribution curves, three 2.5kg laboratory Compaction tests and the SRD results achieved from the site trial at 2, 4, 6 and 8 passes of the roller.

We trust that the above meets with your approval, however should you have any queries and/or you would like to visit the site to inspect the sub formation please do not hesitate to contact me.

Yours sincerely

Matthew Cole
Engineer
for and on behalf of
ENCIA CONSULTING LIMITED
07834 885089

Enc



BARNSLEY

Metropolitan Borough Council

RJH - mrf.

Planning and Transportation Service

Assistant Director: Ruth Middleton, BA (Hons), MRTPI, Dip Surv

Transportation

Transportation Manager, Dr. Andy Chymera, PhD, MRTPI, MIHT.

Central Offices, Kendray Street, Barnsley, S70 2TN

Tel: (01226) 770770 Fax: (01226) 772199

My Ref. KS/PM/B05/15

Your Ref. 5848/01/MC

Date 5th April, 2006

Enquiries to Mrs. K. Smith

Dial Direct (01226)772178

RECEIVED - 7 APR 2006

Dear Sirs,

HIGHWAYS ACT 1980 – SECTION 38 AGREEMENT DEVELOPMENT AT FORMER GOLDTHORPE COLLIERY BY BEN BAILEY HOMES LTD.

I refer to your letter dated 28th March, 2006, regarding the above.

I would confirm that the CBR test results indicate well-consolidated ground conditions below the reinforced concrete and brick fill. I am satisfied that this will provide a suitable formation for the new flexible road construction.

I understand that the reinforced concrete slabs have already been removed and the sub-grade protected with a similar thickness of crushed concrete.

It would be helpful if you, or Ben Bailey Homes, could provide me with a comparison between the levels of the ash layer, which has been tested, and the finished road levels.

It may be possible, subject to further investigation, to reduce the sub-base thickness given the CBR results. I have requested technical advice on this matter and will contact you in due course.

Yours faithfully,

K Smith

for and on behalf of
Transportation Manager

For the attention of Mr. M. Cole
Encia Consulting Limited,
Encia House,
Audby Lane,
Wetherby,
LS22 7RD

Copy to:

Mr. M. Ingram,
Ben Bailey Homes Ltd.,
Elizabeth House,
Cliff Street,
Mexborough,
S64 9HQ

Please address all correspondence to the Transportation Manager

5848/01/MC

28th March 2006

Ms Karen Smith
Barnsley Metropolitan Borough Council
Central Offices
Kendray Street
Barnsley
S70 2TN



Please reply to:

☐ North West
Stone Cross Place,
Stone Cross Lane North, Iowton
WARRINGTON WA3 2SH
T 01942 824406 F 01942 824030

☒ Yorkshire
Encia House,
Audby Lane,
WETHERBY LS22 7RD
T 01937 589955 F 01937 589944

☐ North East
7 Eggleston Court,
Riverside Park,
MIDDLESBROUGH TS2 1RU
T 01642 809088 F 01642 809066

E info@enciagroup.co.uk W enciagroup.co.uk

Dear Karen,

Goldthorpe Colliery, Section 38.

As you are aware it is proposed to enter the above development generally along the line of the existing site access road.

The existing road surface is constructed from reinforced concrete. Six trial pits excavated at approximately 50m centres along the road length show that the concrete is underlain by 700mm (average thickness) of well consolidated ash with some to much gravel of sandstone, brick and clinker which in turn overlies natural strata.

In order to confirm the acceptability of the existing fill three plate bearing tests were carried at a depth *coincident with that of the proposed road formation level*. All of the plate bearing tests achieved a CBR in excess of 31% (Range 31.3% to 36.3%).

The trial pit logs and plate bearing test results with associated CBR calculations are enclosed for your reference.

Given that the in situ fill has been shown to be more than adequate to provide a suitable road formation and that the road has been in place in excess of 20 years, we do not consider it necessary to excavate the full thickness of made ground to allow construction of the new road.

As part of the enabling works we have recommended that the concrete slabs are removed and replaced with a similar thickness of crushed concrete to provide a temporary running surface which we consider will be sufficient to protect the underlying formation.

Ben Bailey Homes' road and sewer contractor will then place new services prior to reducing the level to road formation and constructing the new road to the agreed design.

We trust that this is acceptable, however should you have any queries please do not hesitate to contact me.

Yours sincerely

Matthew Cole
Engineer
for and on behalf of
ENCIA CONSULTING LIMITED

cc Martin Ingram - Ben Bailey Homes
Enc

Our Ref. 9060/RLM/004
Your Ref.

7th March 2005

NHBC Services Ltd
Ash House
Dencora Business Park
Breckland
Linford Wood
Milton Keynes
MK14 6 ET

Dear Sir

Goldthorpe Colliery, Goldthorpe

Our client (Ben Bailey Homes Limited) is seeking approval for remedial works to enable redevelopment the above site with new housing.

Please find enclosed one bound copy of our:

- Goldthorpe Colliery Geoenvironmental Report (No. 2500/1, dated June 2002)
- Remedial Strategy for land at the former Goldthorpe Colliery, Goldthorpe (Report No. 9060/1, dated March 2005)

We trust the enclosed meets with your approval, but please contact the sender with any queries.

Yours sincerely

Richard Meredith
for and on behalf of
ENCIA CONSULTING LIMITED

cc Philip Barringer - Ben Bailey Homes Limited

Our Ref. 9060/RLM/005
Your Ref. B/04/2330/DE

7th March 2005

Miranda Stedman
Barnsley MBC
Plannning and Transportation Service
Central Offices
Kendray Street
Barnsley
S70 2TN

Dear Miranda

Goldthorpe Colliery, Goldthorpe

Our client (Ben Bailey Homes Limited) is seeking approval for remedial works to enable redevelopment the above site with new housing as per the Grant of Planning Permission (Application No. B/04/2330/DE).

Please find enclosed one bound copy of our Remedial Strategy for land at the former Goldthorpe Colliery, Goldthorpe (Report No. 9060/1, dated March 2005) fro your approval.

We trust the enclosed meets with your approval, but please contact the sender with any queries.

Yours sincerely

Richard Meredith
for and on behalf of
ENCIA CONSULTING LIMITED

cc Philip Barringer - Ben Bailey Homes Limited

2500/1/RLM

5th January 2005

Mr P Barringer
Ben Bailey Homes Ltd
Elizabeth House
Cliff Street
Mexborough
South Yorkshire
S64 9HQ

Dear Phil

Development at Goldthorpe Colliery

This letter, which should be read in conjunction with Report No 2500/1, provides an assessment of the soil-gas risk present and makes appropriate recommendations in light of redevelopment of the site.

1. Background

The site is situated approximately 11km west of Barnsley town centre, South Yorkshire. The whole site covers an area of approximately 27 hectares and can be divided into two main areas:

- **Area 1:** The former main colliery site, with outline planning for residential development (c. 11.5 ha)
- **Area 2:** Includes the former main colliery spoil tip (Spoil Tip No.1)

Historical Ordnance Survey plans indicate the site to have been occupied by a colliery.

Ground conditions at the site generally comprise a variable cover of made ground over firm and stiff clay or dense sand and gravel, over Middle Coal Measures and Ackworth Rock bedrock.

Although the site does not lie within the statutory consultation zone of a former landfill site, there is a potential for coal/mine gas migration into the site from both mine workings and colliery spoil tips on the site.

Based on the above, it was considered that hazardous gas posed a potential risk to the proposed development. Monitoring wells were therefore installed in ten probeholes; details of the individual installations are provided in Report No. 2500/1.

2. Scope of Works

The wells have been monitored on ten occasions between 25th April and 15th November 2002 for groundwater levels and soils-gases. A standard procedure was followed in accordance with CIRIA guidance; this procedure involved measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring.

- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data LMSx infra-red gas analyser.
- Standing water level using a dipmeter.

3. Gas Monitoring Results

The results of the gas monitoring are enclosed and summarised in Table 1 below.

Table 1 - Summary of gas monitoring results

Monitoring Well	Methane Concentrations (% v/v)	Range of Carbon Dioxide Concentrations (% v/v)	Range of Positive Flow Rates (litre/hour)
PH101	0.0	0.0 - 8.7	0.0 - 0.8
PH102	0.0	0.0 - 4.4	0.0 - 0.8
PH103	0.0	0.3 - 1.2	0.0 - 0.1
PH104	0.0	0.0 - 13.0	0.0 - 1.1
PH105	0.0	0.1 - 5.1	0.0 - 0.2
PH106	0.0	0.0 - 5.8	0.0 - 0.4
PH107	0.0	0.0 - 4.7	0.0 - 1.0
PH108	0.0	1.9 - 4.7	0.0 - 0.3
PH109	0.0	0.2 - 3.3	0.0 - 0.3
PH110	0.0	0.1 - 2.0	0.0 - 0.4

No methane was recorded during the monitoring period. Carbon dioxide concentrations in excess of 1.5% by volume (v/v) were recorded in all but one location, PH 103, whilst concentrations in excess of 5% by volume (v/v) were recorded in PH's 101, 104, 105 and 106.

Elevated concentrations of carbon dioxide were encountered within the wells to a maximum of 13% v/v. The monitoring was undertaken over a range of barometric pressures from 986 to 1016 mb.

Low gas flow rates were recorded throughout the monitoring period from each of the ten wells, with a maximum of 1.1 litre/hour.

4. Current Guidance

Guidance in Waste Management Paper 27, 1991 recommends that no dwellings should be constructed within 50m of any landfill that has the capacity to produce large volumes of landfill gas. However, development closer to landfill has been permitted where appropriate gas exclusion measures have been satisfactorily installed.

CIRIA Report 151 (1995)¹ identified that there is currently inadequate guidance on trigger concentrations for ground gases. The current emphasis on using gas concentrations for trigger values particularly in Waste Management Paper 27² and the Building Regulations³,

¹ Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151

² DoE (1989a). Waste Management Paper No. 27. The control of landfill gas. Department of the Environment, HMSO, London

should be revised to consider gas pressures, borehole flow rates and estimated surface emission rates.

It was concluded that the most important aspect of relating the gas regime below or adjacent to a site, to the risk it poses to any development, is the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk.

CIRIA Report 149 (1995)⁴, reference Table 28, reviewed over 100 case studies of development affected by gas to establish current UK practices for gas control. The report classified the gassing regimes found within 6 Characteristic Situations. The highest measured parameter, either methane or carbon dioxide concentration and/or emission rate were used to define the Characteristic Situation for each case history site. The report then related the typical range of mitigation measures that had been adopted at each study site to the characteristic gas situation.

To achieve a more consistent design of protection measures Table 28 of CIRIA 149 was rewritten (Wilson and Card, 1999)⁵ in terms of borehole gas volume flow rate and gas concentrations. This was done to reflect the importance of recognising the gas surface emission rate.

5. Current Gas Regime

According to the Building Regulations, Document C, consideration should be given to installation of gas protection measures where the concentration of carbon dioxide is greater than 5% by volume (v/v). The maximum recorded during the monitoring period was 13% v/v.

Site classification should generally be based on results obtained over a prolonged period, usually in excess of 6 months (and in excess of 12 months if significant concentrations and flows of methane are recorded). However, no methane has been recorded in any of the wells installed at the site.

The worse-case borehole gas volume flow for carbon dioxide is less than 0.0408 litres/hour, although the worse-case concentration of carbon dioxide of 13% would place the site in Characteristic Situation 2.

Based on this assessment it is considered that the elevated concentrations of carbon dioxide should not prohibit development of the site. However, gas protection measures as outlined below will need to be incorporated into new housing. These measures are, however, subject to the approval of NHBC, EA and the Environmental Health Department of Barnsley Metropolitan Council, who may request that data be collected over an extended period (say 6 months to 1 year).

6. Conclusions

Monitored soil-gas concentrations across the site are considered to be significant. Observed concentrations to date indicate the presence of a maximum concentration of 13% v/v of carbon dioxide.

³ DoE (1992). Building Regulations, Approved Document C. HMSO, London.

⁴ Card GB (1995). Protecting Development from Methane. CIRIA Report 149

⁵ Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

To enable safe redevelopment of the site, bearing in mind the aforementioned comments, it is recommended that the following mitigation measures be allowed for in **all** new dwellings at the site.

- well constructed suspended floor slab
- 1200 gauge membrane incorporated in the slab and sealed with top hats around service entries. The membrane should be sealed to the manufactures specification;
- passively ventilated sub-space and wall cavities;
- minimum penetration of floor slab by services and minimum number of confined spaces such as cupboards above the slab. Any confined spaces should be ventilated;

The passively ventilated sub-space should be of the following design to provide sufficient air flow to maintain gas concentrations in the void space to well below target concentrations:

- minimum clear open void depth of 200 mm;
- cross ventilation on two opposite faces of the open void;
- ventilation set at a minimum of 2652 mm²/m run of wall;

An essential factor to ensure the efficacy of the proposed mitigation measures is to provide a high standard of supervision and quality assurance checking throughout the duration of installing gas mitigation measures and associated remedial works. Independent validation should be carried out by specialist personnel and a Completion Report prepared to detail the implemented measures.

We trust the above is sufficient for you present needs, but should you have any queries, please contact the undersigned.

Yours sincerely

Richard Meredith
for and on behalf of
ENCIA CONSULTANTS LTD

Enc.

APPENDIX C

Geotechnical Testing

APPENDIX C(i)
Classification of Class 6F2

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

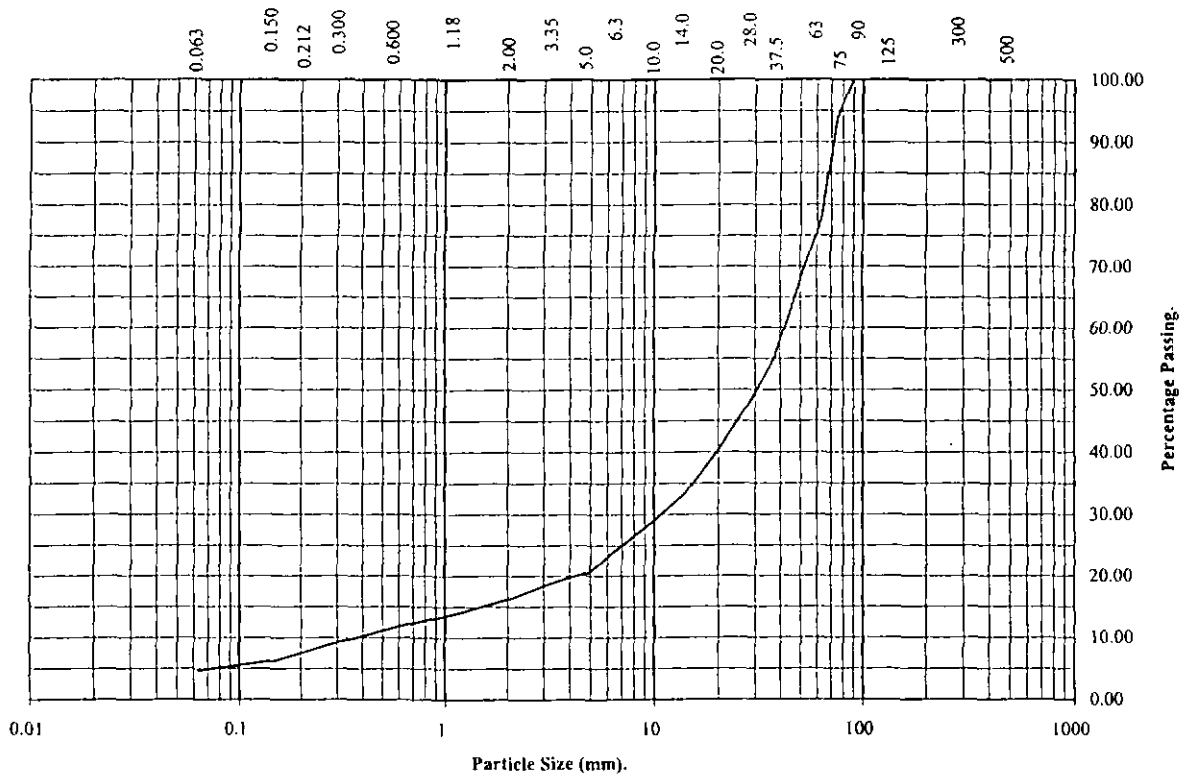
Wet Sieve: Clause 9.2

Classification for Acceptable Earthworks

Stockpile

Classification Type

6F2



BS Test Sieve	Percentage Passing	Table 6/2 Grading Requirements
500	100	
300	100	
125	100	100
90	100	80-100
75	94	65-100
63	78	
37.5	55	45-100
28	48	
20	40	
14	33	
10	29	15-60
6.3	24	
5	21	10-45
3.35	19	
2	16	
1.18	14	
0.6	12	0-25
0.3	9	
0.212	8	
0.15	6	
0.063	5	0-12

Soil Fraction	Total Percentage
Cobbles	22
Gravel	62
Sand	11
Silt/Clay	5

Remarks:

Passes 6F2 Criteria

Checked and Approved By

Date



GOLDTHORPE COLLIERY.

Contract No.:

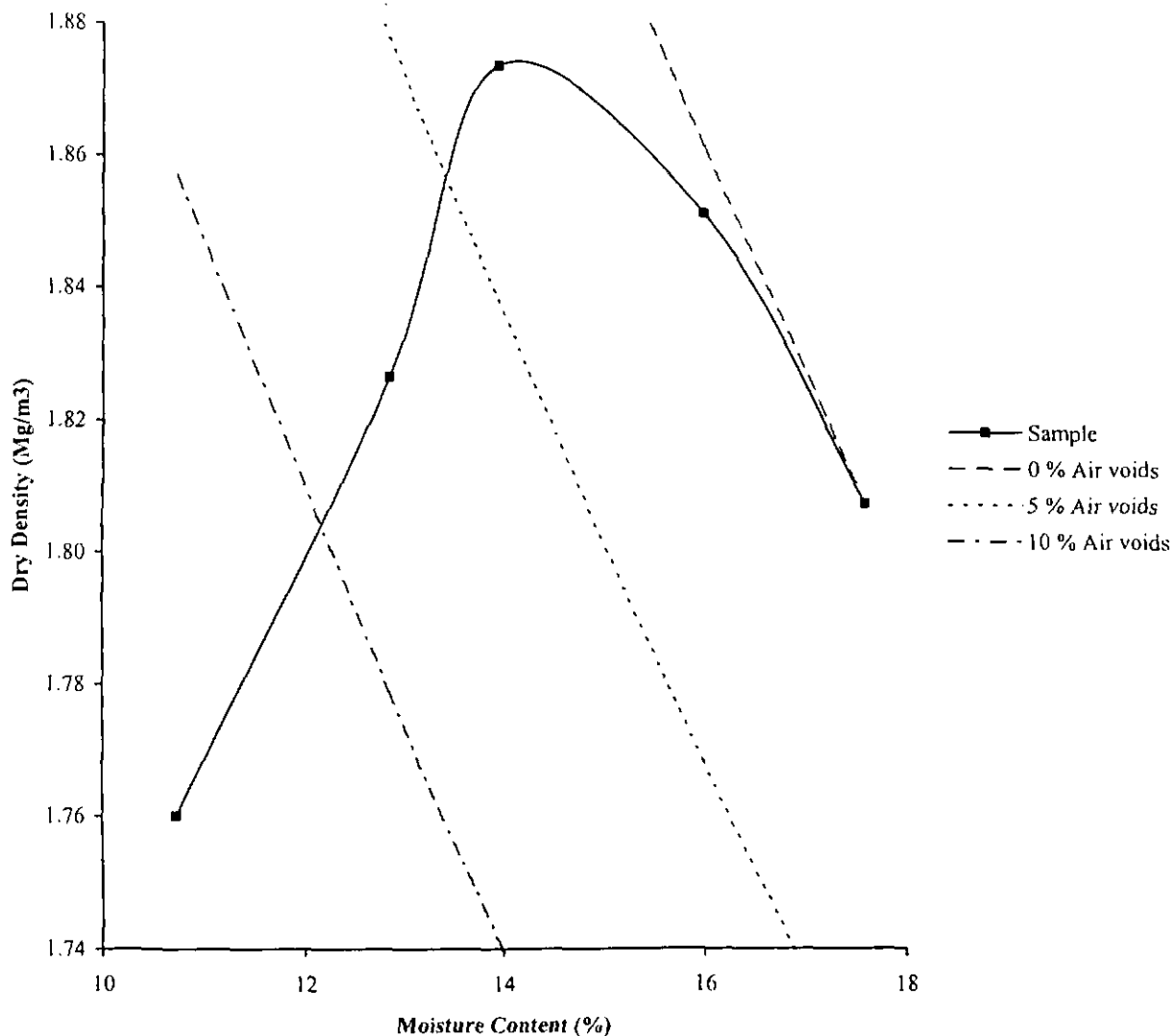
PSL06/603

Dry Density/Moisture Content Relationship Test

Non Compliance With BS 1377 : Part 4 : 1990

Stockpile

6f2



Initial Moisture Content:	11	Method of Compaction	Vibro Hammer /	Separate Sample
Particle Density (Mg/m ³):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	45
Maximum Dry Density (mg/m ³):	1.88		Material Retained on 20.0 mm Test Sieve (%):	15
Optimum Moisture Content (%):	14			
Remarks	Passes 6f2 criteria.			

Checked By	Date	Approved By	Date



GOLDTHORPE COLLIERY.

Contract No.
PSL06/603

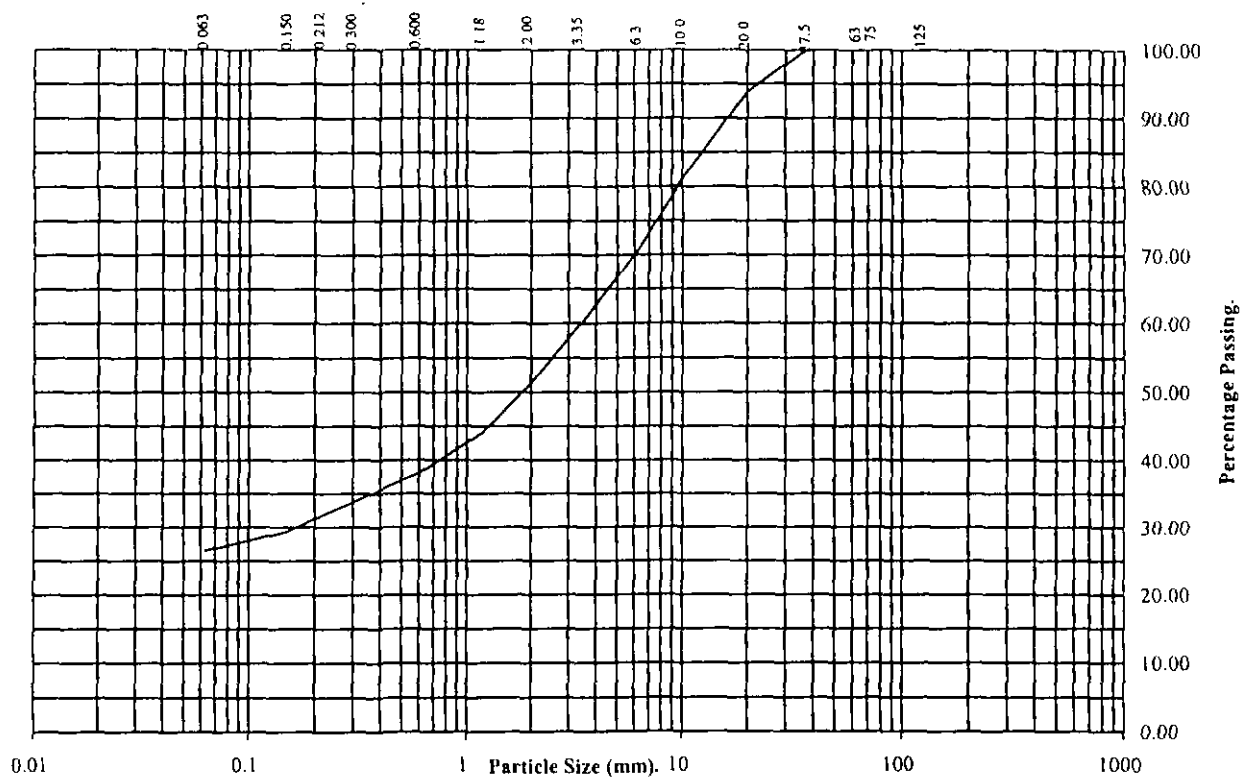
APPENDIX C(ii)
Classification of Class 2C

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

Sample Number: 1



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	81
6.3	71
3.35	60
2	51
1.18	44
0.6	38
0.3	34
0.212	32
0.15	29
0.063	26

Soil Fraction	Total Percentage
Cobbles	0
Gravel	49
Sand	25
Silt/Clay	26

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

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GOLDTHORPE COLLIERY.

Contract No.:

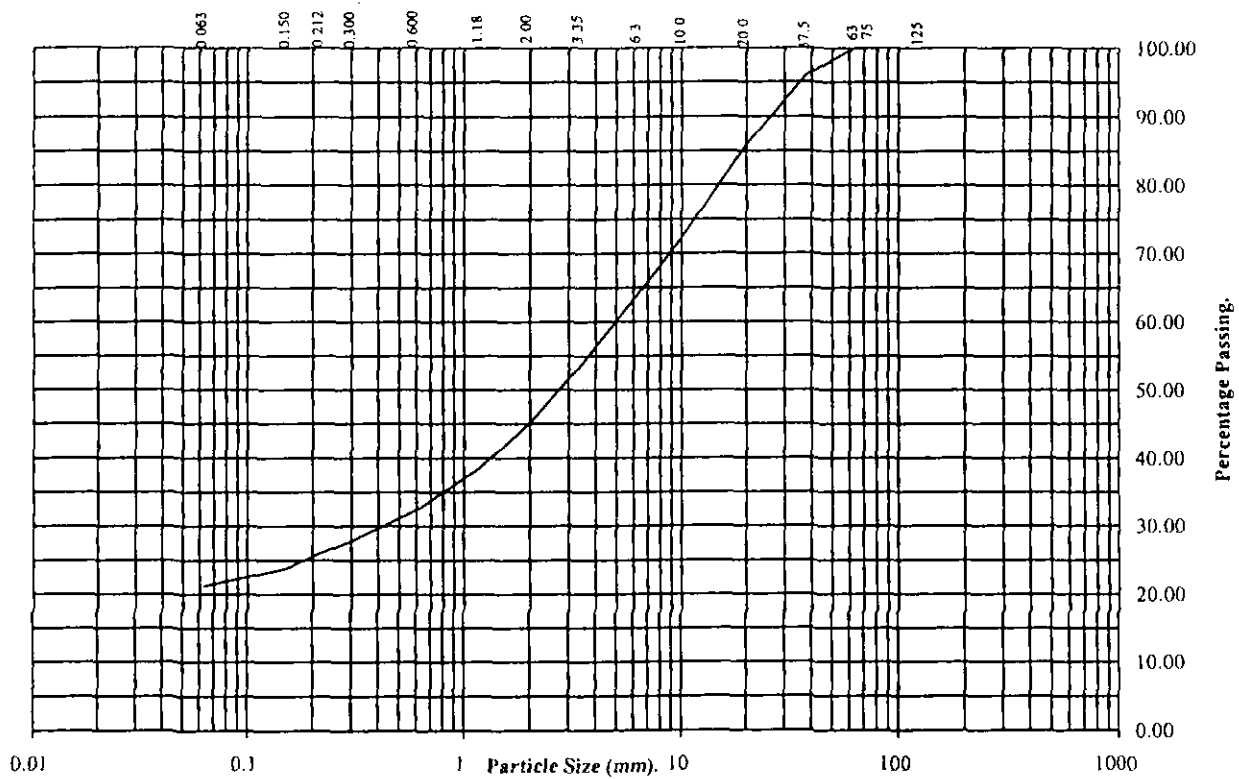
PSL06/603

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

Sample Number: 2



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	96
20	86
10	72
6.3	64
3.35	53
2	45
1.18	39
0.6	32
0.3	28
0.212	26
0.15	24
0.063	21

Soil Fraction	Total Percentage
Cobbles	0
Gravel	55
Sand	24
Silt/Clay	21

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

GOLDTHORPE COLLIERY.

Contract No.:

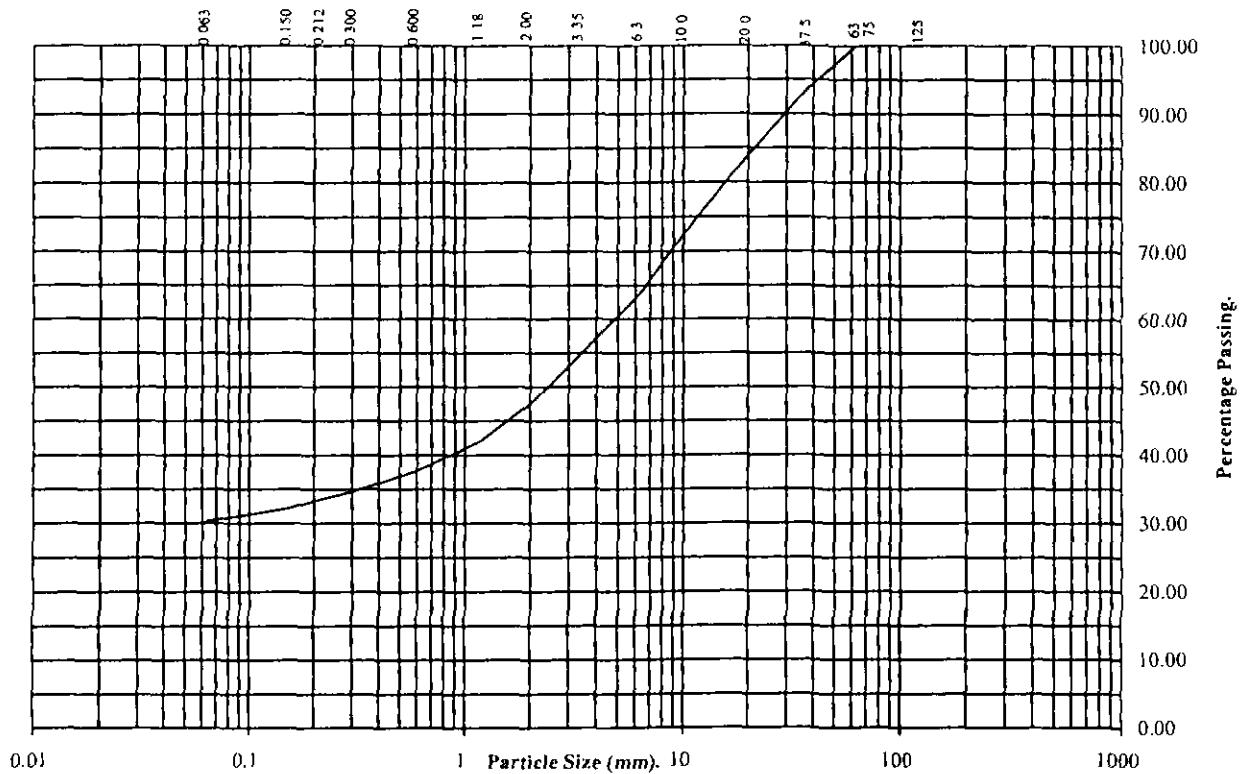
PSL06/603

PARTICLE SIZE DISTRIBUTION TEST

BS1377:Part 2:1990

Wet Sieve: Clause 9.2

Sample Number: 3



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	94
20	84
10	72
6.3	64
3.35	55
2	47
1.18	42
0.6	38
0.3	35
0.212	33
0.15	32
0.063	30

Soil Fraction	Total Percentage
Cobbles	0
Gravel	53
Sand	17
Silt/Clay	30

Remarks:
See summary of soil descriptions.

Checked By	Date	Approved By	Date

PSL

Professional Soils Laboratory

GOLDTHORPE COLLIERY.

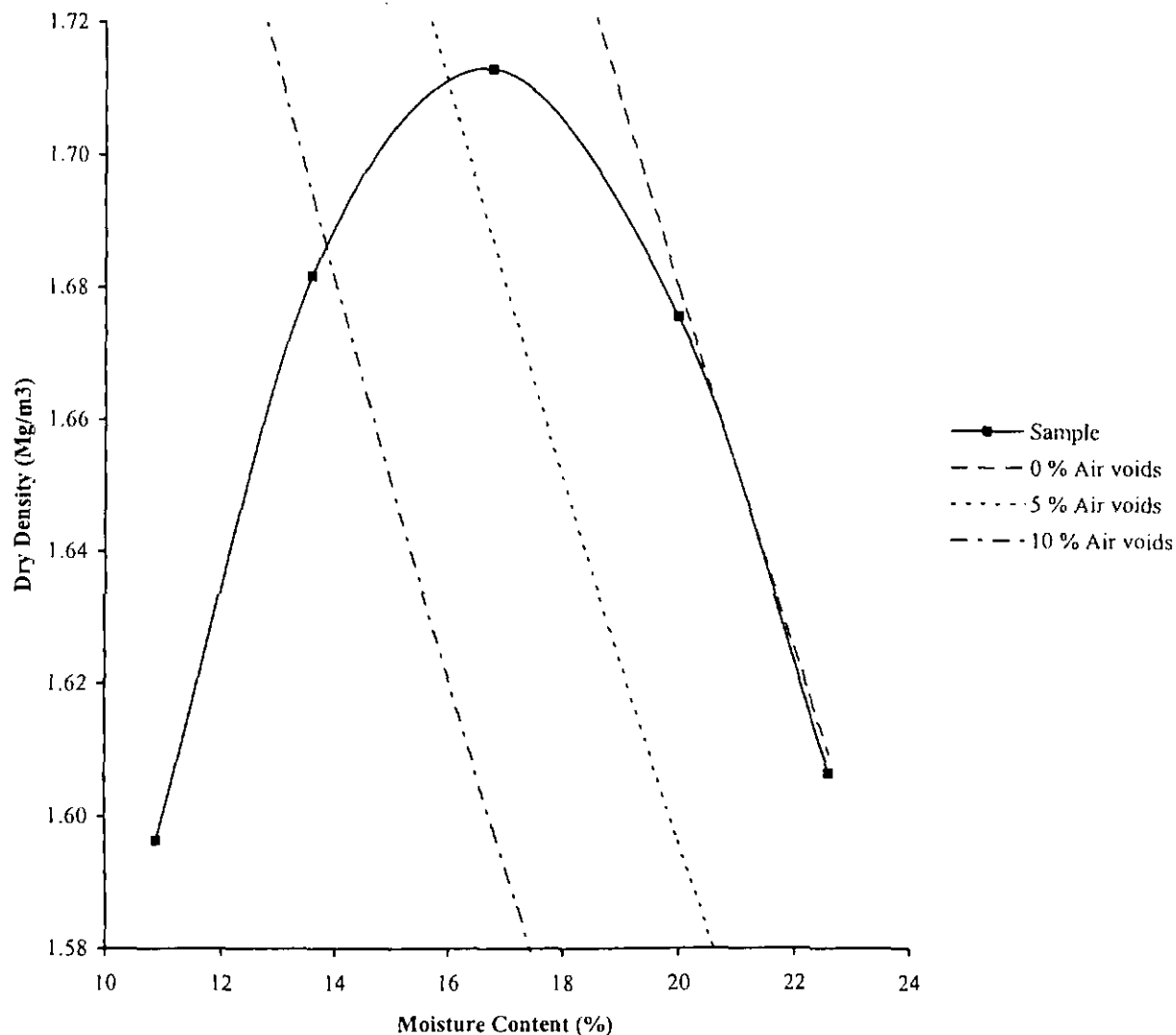
Contract No.:

PSL06/603

Dry Density/Moisture Content Relationship Test

BS 1377 : Part 4 : 1990

Sample Number: 1



Initial Moisture Content:	17	Method of Compaction	2.5Kg / Separate Sample
Particle Density (Mg/m³):	2.53	Actual	Material Retained on 37.5 mm Test Sieve (%): 0
Maximum Dry Density (mg/m³):	1.71		Material Retained on 20.0 mm Test Sieve (%): 6
Optimum Moisture Content (%):	17		
Remarks	See summary of soil descriptions.		

Checked By	Date	Approved By	Date



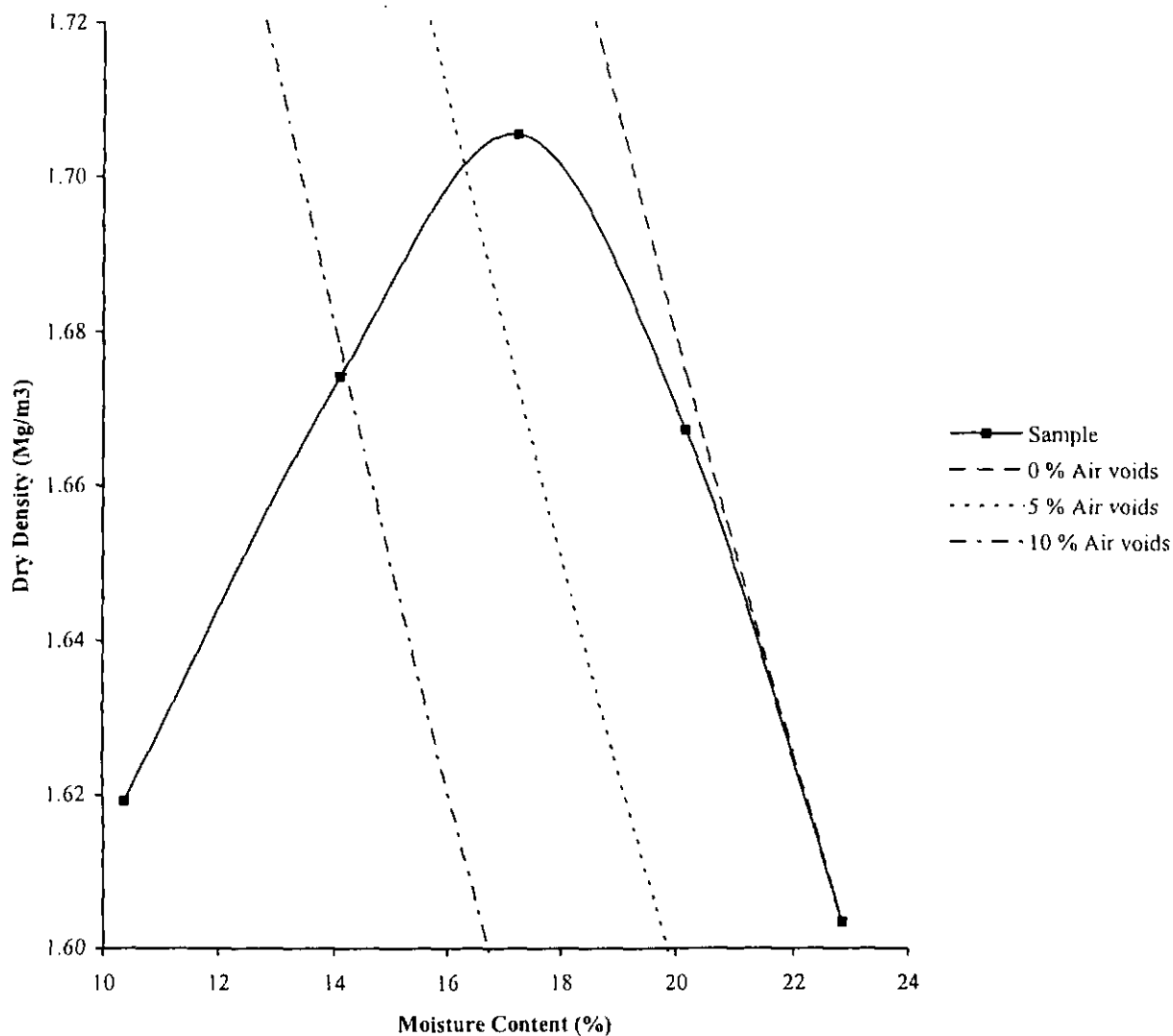
GOLDTHORPE COLLIERY.

Contract No.
PSL06/603

Dry Density/Moisture Content Relationship Test

BS 1377 : Part 4 : 1990

Sample Number: 2



Initial Moisture Content:	17	Method of Compaction	2.5Kg / Separate Sample
Particle Density (Mg/m³):	2.53	Actual	Material Retained on 37.5 mm Test Sieve (%): 4
Maximum Dry Density (mg/m³):	1.71		Material Retained on 20.0 mm Test Sieve (%): 10
Optimum Moisture Content (%):	17		
Remarks	See summary of soil descriptions.		

Checked By	Date	Approved By	Date



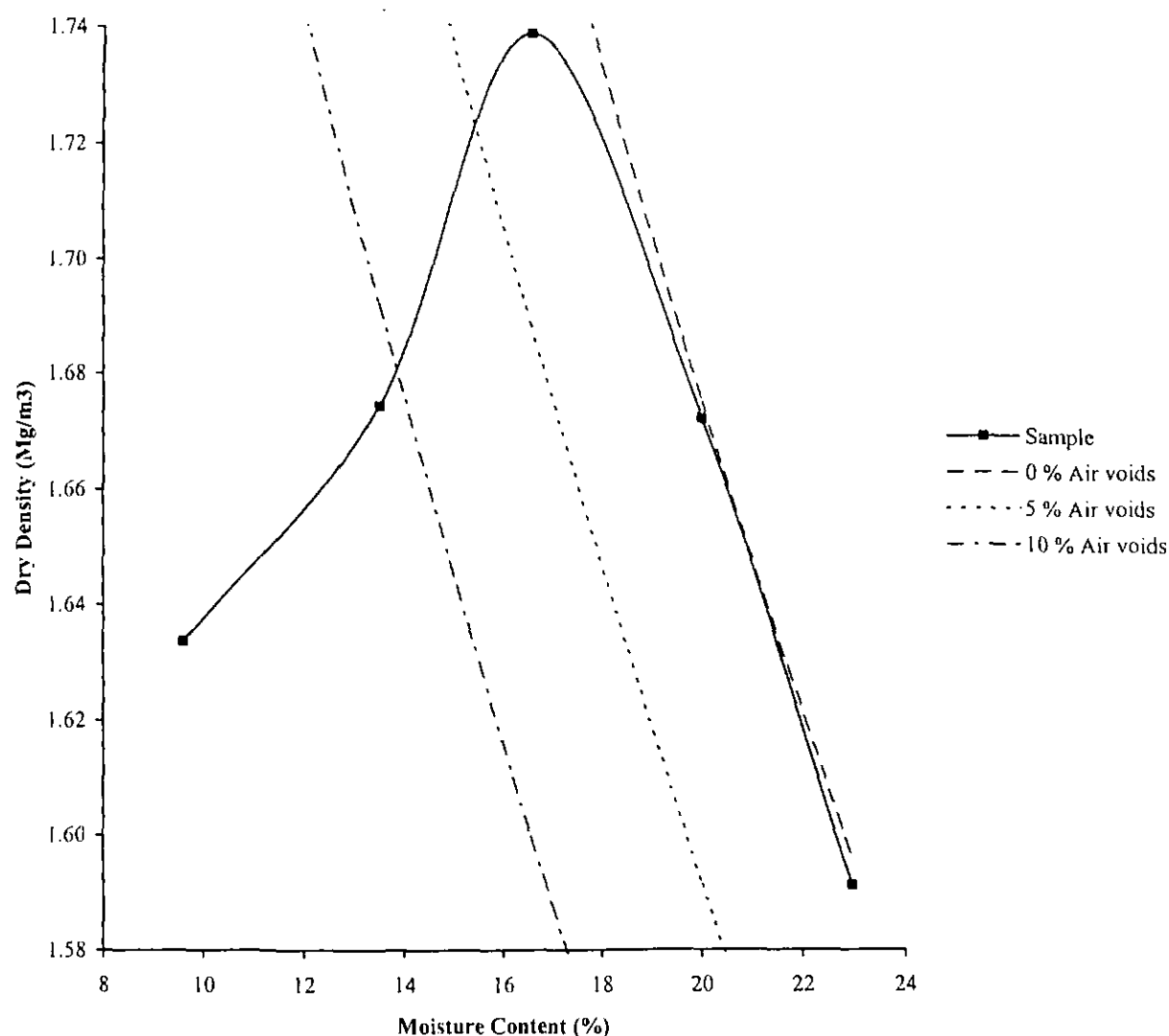
GOLDTHORPE COLLIERY.

Contract No.
PSL06/603

Dry Density/Moisture Content Relationship Test

BS 1377 : Part 4 : 1990

Sample Number: 3



Initial Moisture Content:	17	Method of Compaction	2.5Kg / Separate Sample
Particle Density (Mg/m³):	2.52	Actual	Material Retained on 37.5 mm Test Sieve (%): 6
Maximum Dry Density (mg/m³):	1.74		Material Retained on 20.0 mm Test Sieve (%): 10
Optimum Moisture Content (%):	17		
Remarks	See summary of soil descriptions.		

Checked By	Date	Approved By	Date



GOLDTHORPE COLLIERY.

Contract No.
PSL06/603

APPENDIX C(iii)
Class 2C Site Trial

SUMMARY OF INSITU TESTS

BS 1377 : Part 9 : 1990.

[illegible]

*: C.B.R: California Bearing Ratio.

Sheet 1 of 1.



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GOLDTHORPE COLLIERY.					Contract No PSL06/603
					Figure:

Doncaster DN4 0AG.

APPENDIX C(iv)
Plate Bearing Test Results

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **26/03/2006**

Test Number: **1**

Engineer: **MJC**

Test Position: **Acces Road**

Fill Type: **Existing Ash Fill**

Depth: **Prop. Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.43	mm
Settlement at end of reload loop:	2.25	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.82	mm
Reload settlement < 1.27mm; K =	141	kPa
Correction for plate diameter; K _{mod} =	113	kPa
Subgrade CBR =	31	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52) \times 49)}$

PSL**Professional Soils Laboratory**

Independent Laboratory Testing Services.

Professional Soils Laboratory
5/7 Hexthorpe Road
Hexthorpe
Doncaster, DN4 0AG
tel: 0870 2401964, fax: 0870 2401965
email: awatkins@prosoils.co.uk

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 20-Mar-06

Test Position: 1

Depth (m): 0.50m below ERL

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

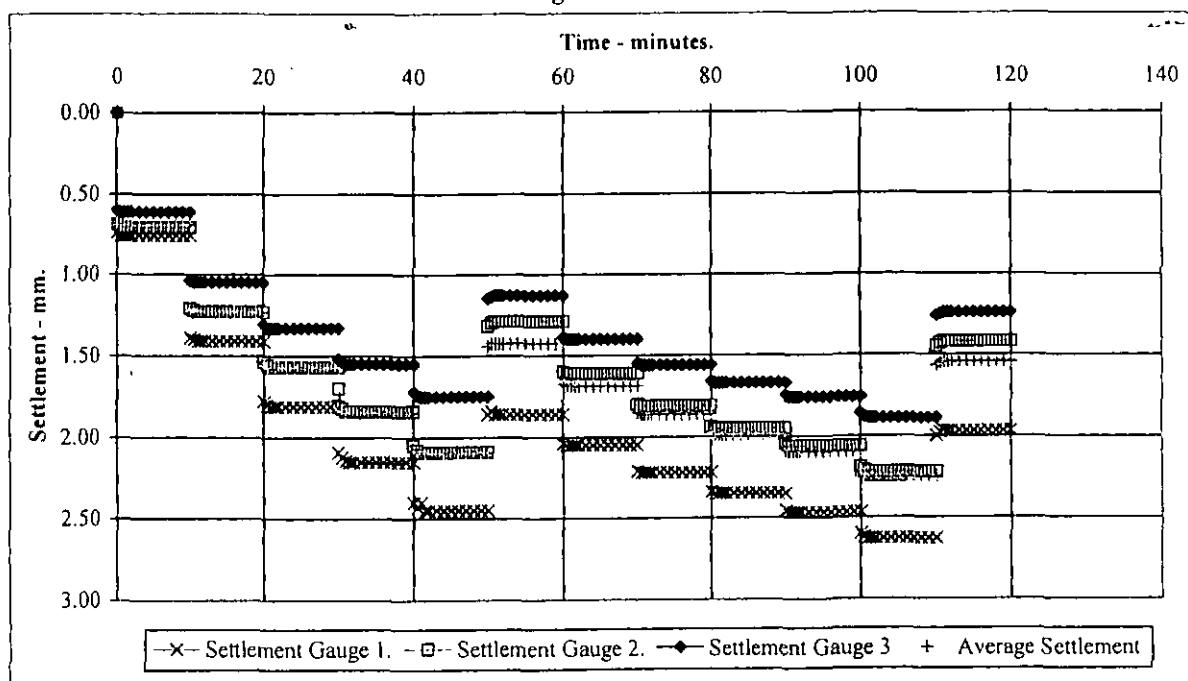
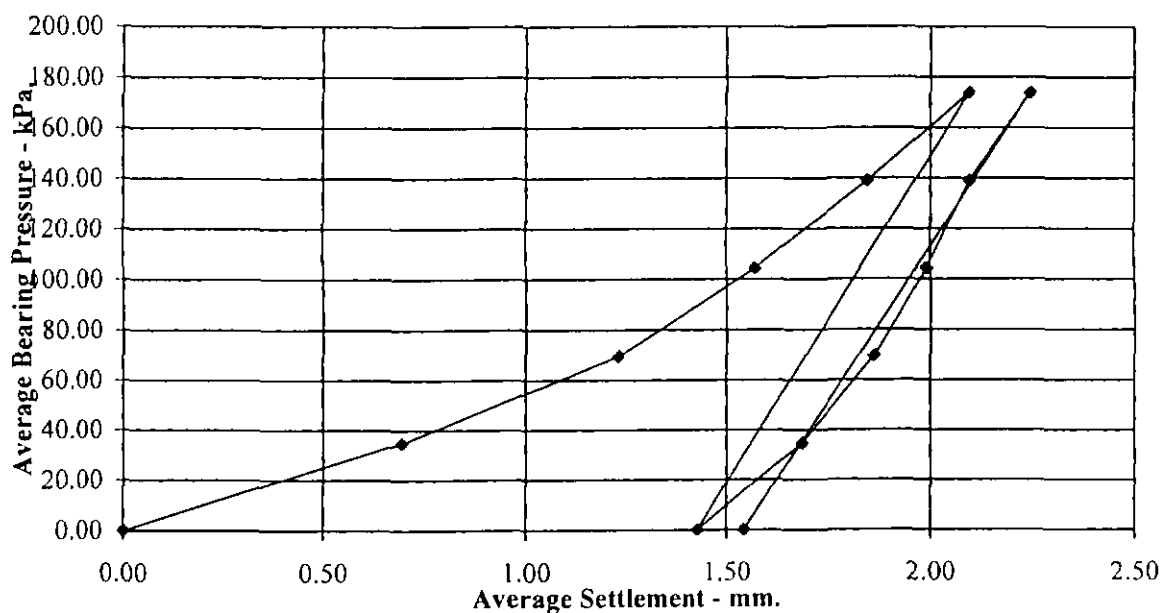
173.76

Maximum Deformation (mm):

2.25

Description:

Existing Ash Fill.



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Checked By

Date

Approved By

Date

Contract No.

21/3/06

21/3/06

21/3/06

PSL06/511

GOLDTHORPE COLLIERY

Client Ref.

RECEIVED 22 MAR 2006 24873

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **26/03/2006**

Test Number: **2**

Engineer: **MJC**

Test Position: **Acces Road**

Fill Type: **Existing Ash Fill**

Depth: **Prop. Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.74	mm
Settlement at end of reload loop:	1.52	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.78	mm
Reload settlement < 1.27mm; K =	149	kPa
Correction for plate diameter; K _{mod} =	119	kPa
Subgrade CBR =	33	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67 \text{ kPa}$), $\text{CBR} = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67 \text{ kPa}$), $\text{CBR} = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 20-Mar-06

Test Position: 2

Depth (m): 0.50m below ERL

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

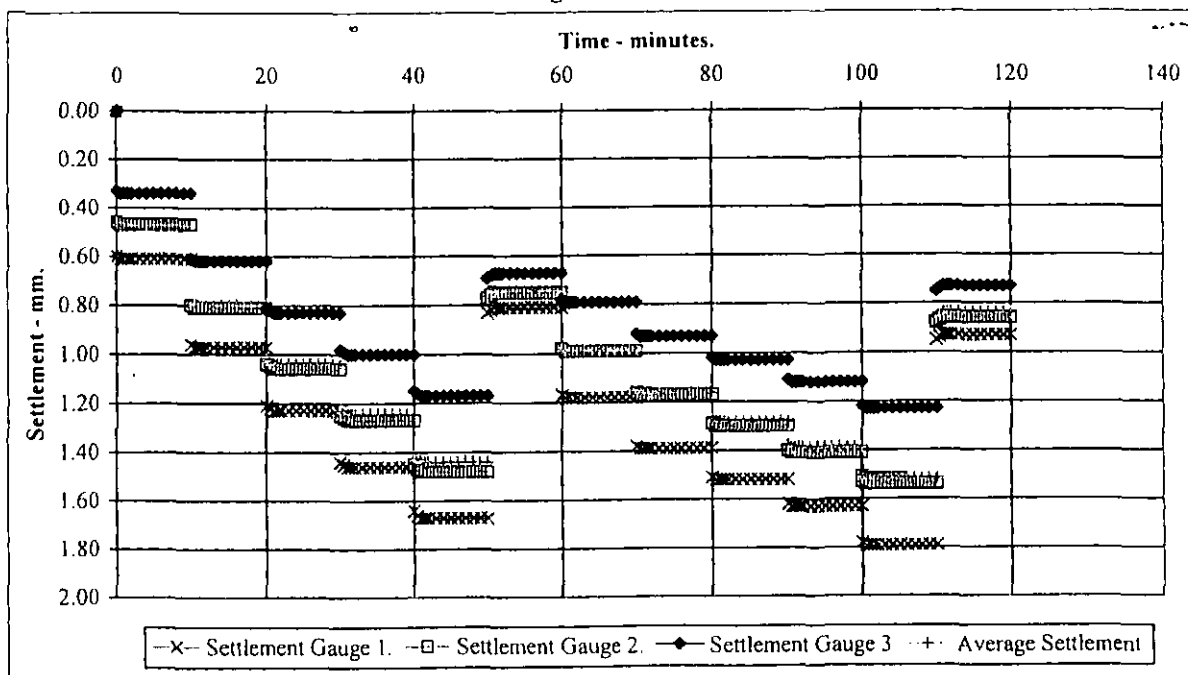
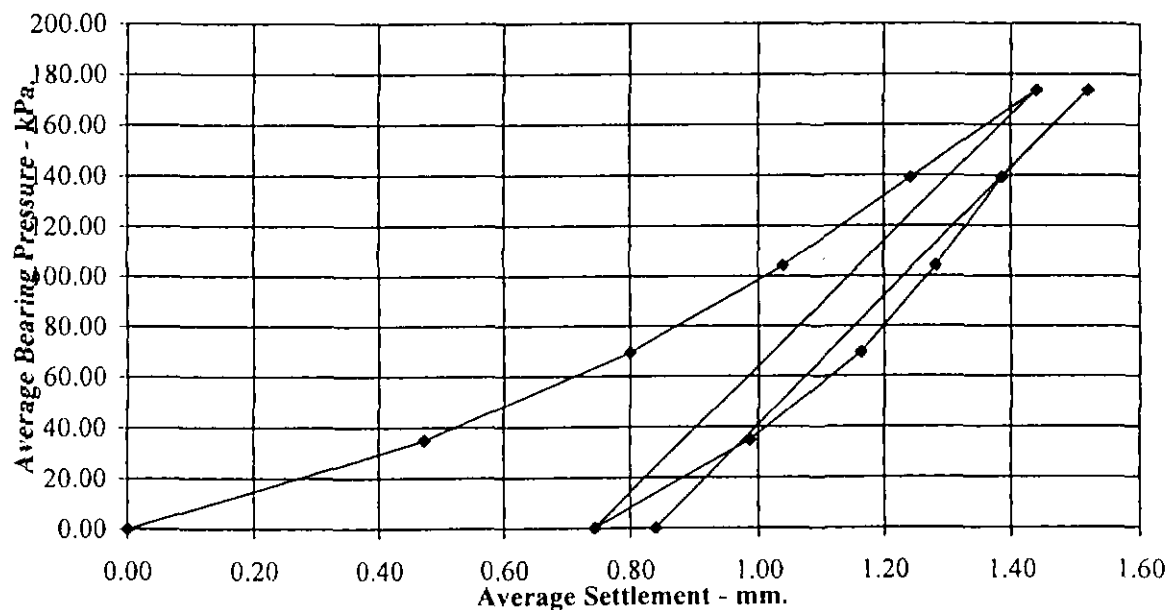
173.76

Maximum Deformation (mm):

1.52

Description:

Existing Ash Fill.



—x— Settlement Gauge 1. —□— Settlement Gauge 2. —◆— Settlement Gauge 3. —+— Average Settlement

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<i>[Signature]</i>	21/3/06	<i>[Signature]</i>	21/3/06	<i>[Signature]</i>	21/3/06	PSL06/511
GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **26/03/2006**

Test Number: **3**

Engineer: **MJC**

Test Position: **Acces Road**

Fill Type: **Existing Ash Fill**

Depth: **Prop. Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.53	mm
Settlement at end of reload loop:	1.29	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.76	mm
Reload settlement < 1.27mm; K =	152	kPa
Correction for plate diameter; K _{mod} =	122	kPa
Subgrade CBR =	34	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \cdot 224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 20-Mar-06

Test Position: 3

Depth (m): 0.50m below ERL

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

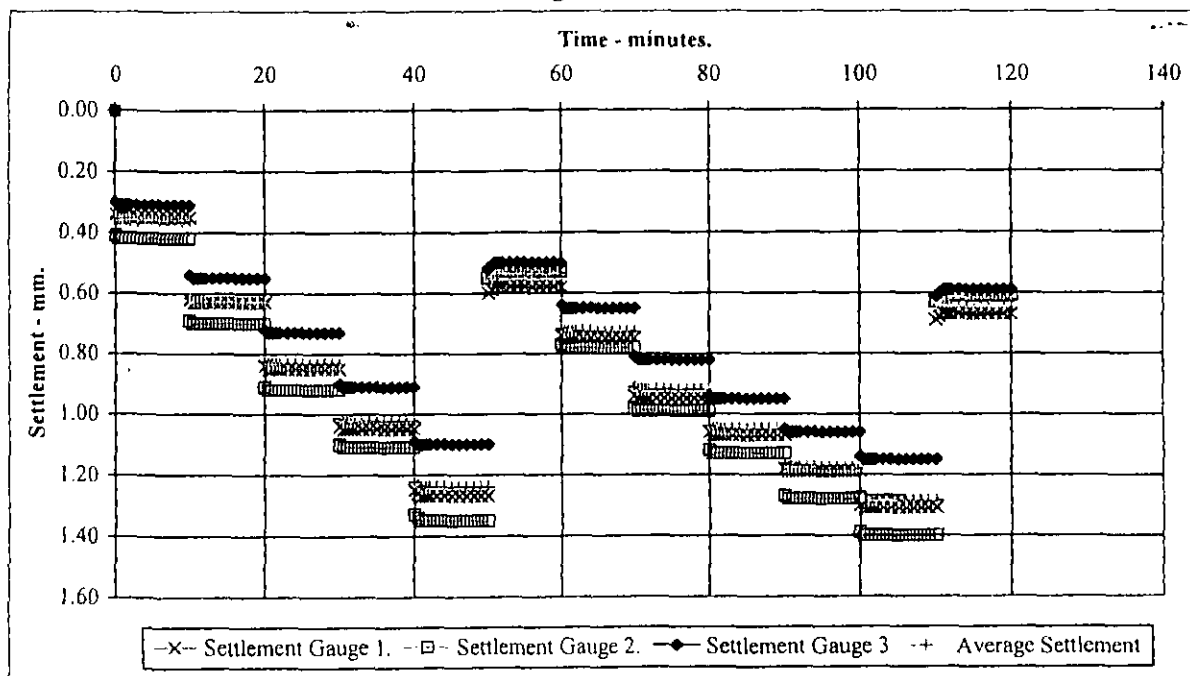
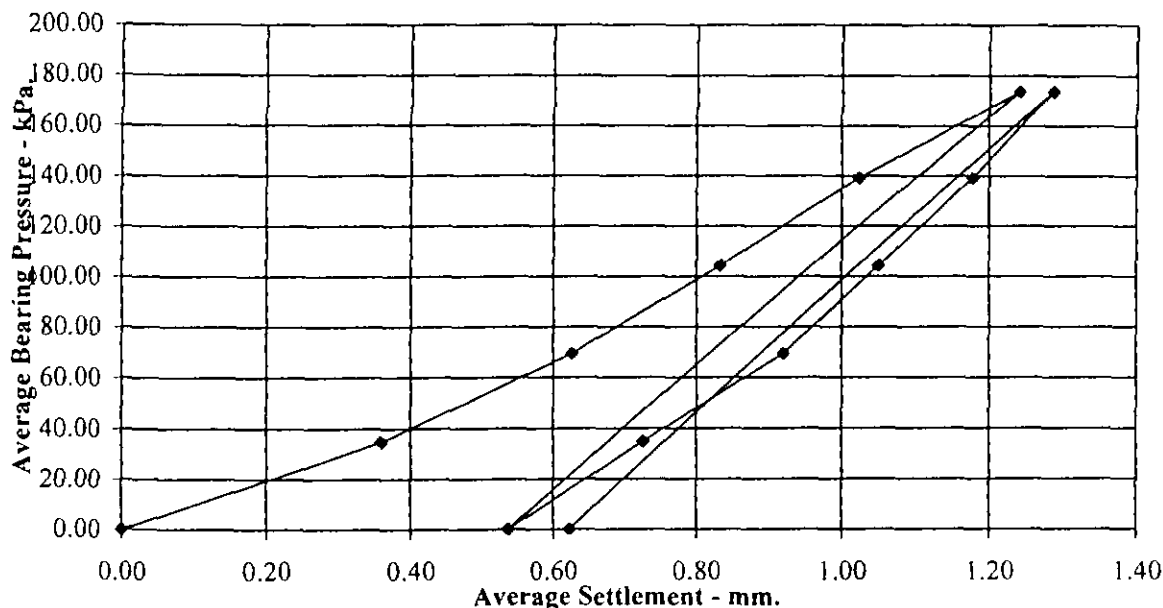
173.76

Maximum Deformation (mm):

1.29

Description:

Existing Ash Fill.



-x- Settlement Gauge 1. -□- Settlement Gauge 2. -◆- Settlement Gauge 3 -+ Average Settlement

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<i>[Signature]</i>	21/3/06	<i>[Signature]</i>	21/3/06	<i>[Signature]</i>	21/3/06	PSL06/511
GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **4**

Engineer: **MJC**

Test Position: **Rd 3 20m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.83	mm
Settlement at end of reload loop:	1.61	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.78	mm
Reload settlement < 1.27mm; K =	148	kPa
Correction for plate diameter; K_{mod} =	118	kPa
Subgrade CBR =	33	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K / 52) \times 48)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 04-Apr-06

Test Position: PBT4, Rd 3, 20mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

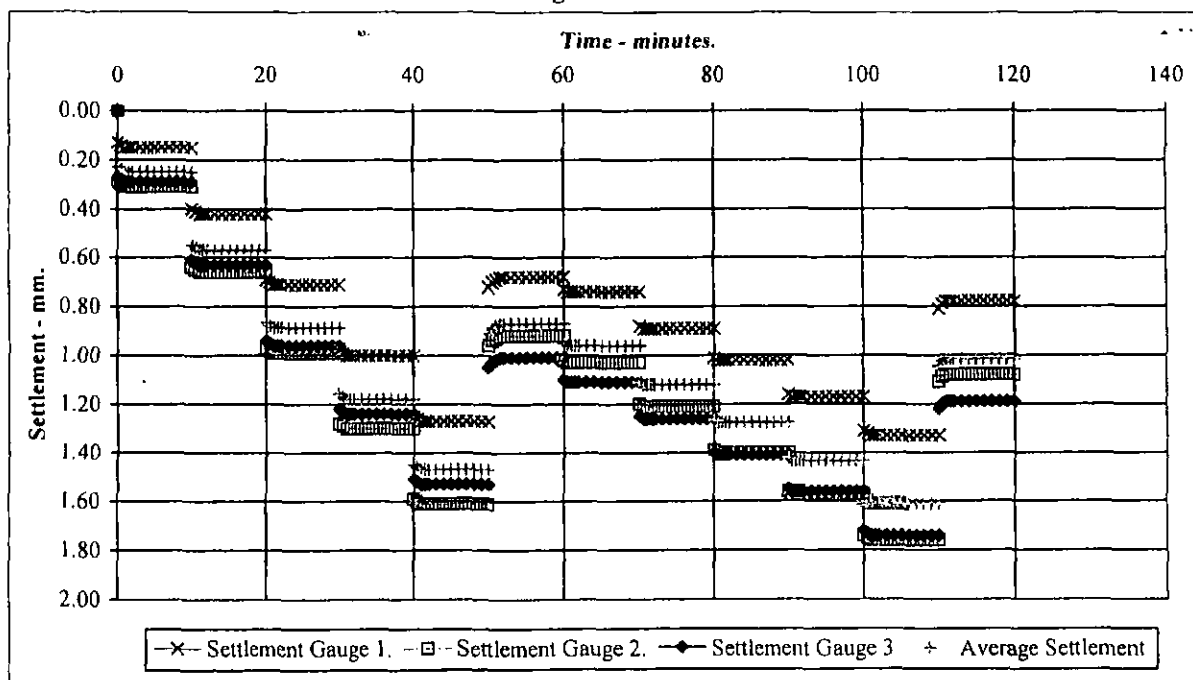
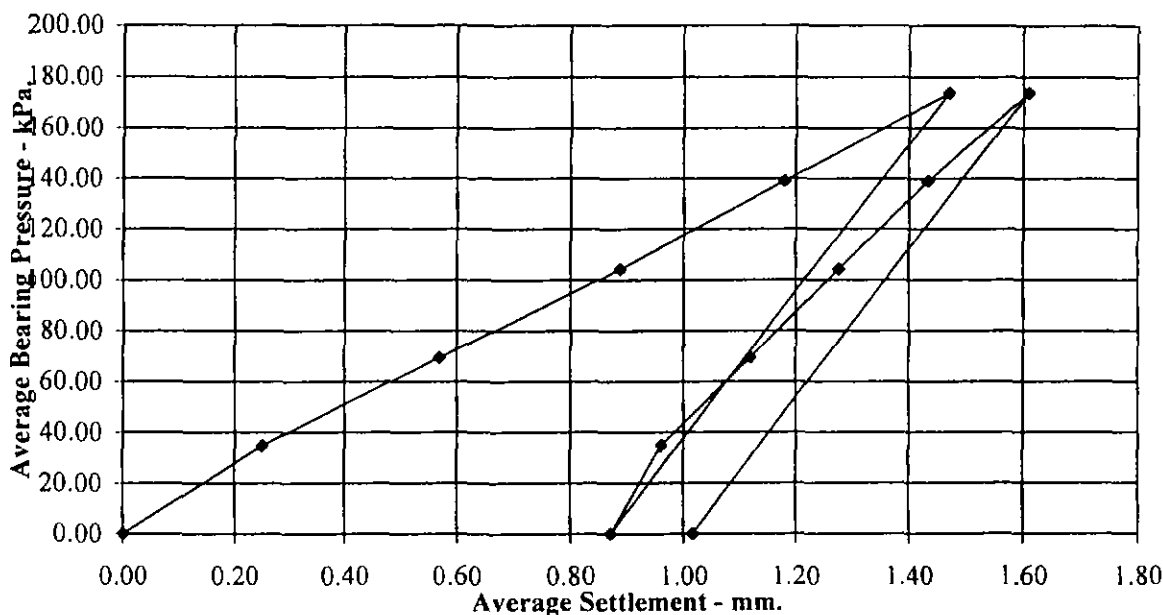
173.76

Maximum Deformation (mm):

1.61

Description:

6F2.



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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **5**

Engineer: **MJC**

Test Position: **Rd 3 45m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.80	mm
Settlement at end of reload loop:	1.46	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.66	mm
Reload settlement < 1.27mm; K =	176	kPa
Correction for plate diameter; K_{mod} =	140	kPa
Subgrade CBR =	42	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K+224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 04-Apr-06

Test Position: PBT5, Rd 3, 45mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

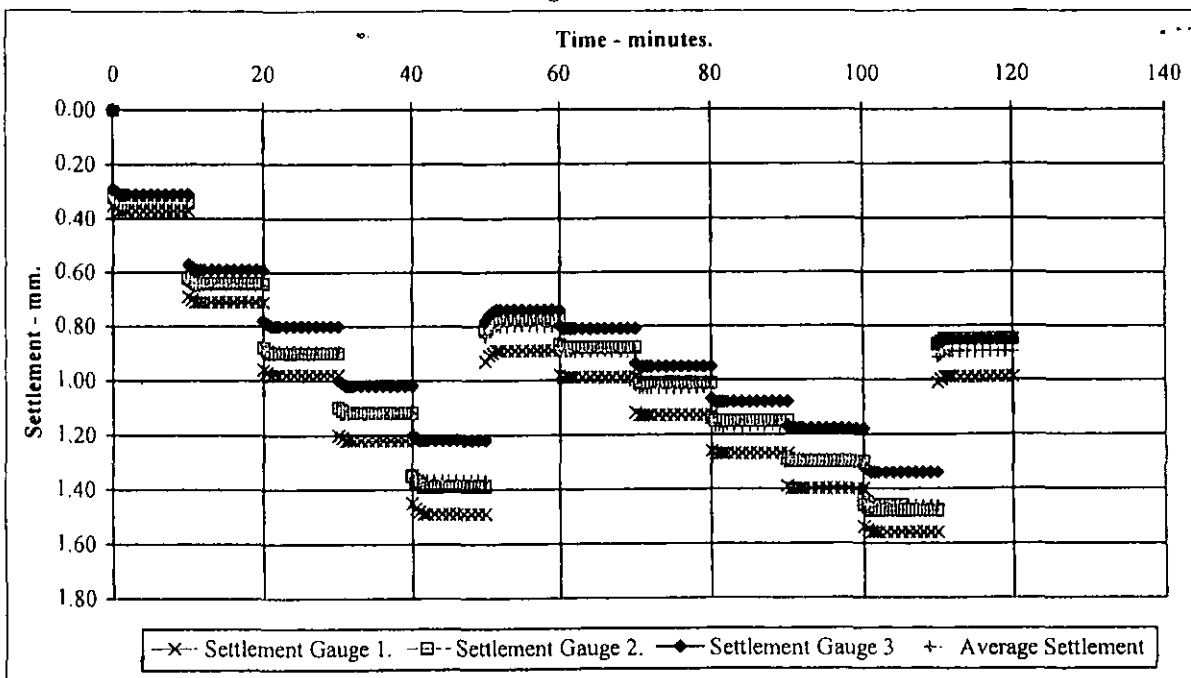
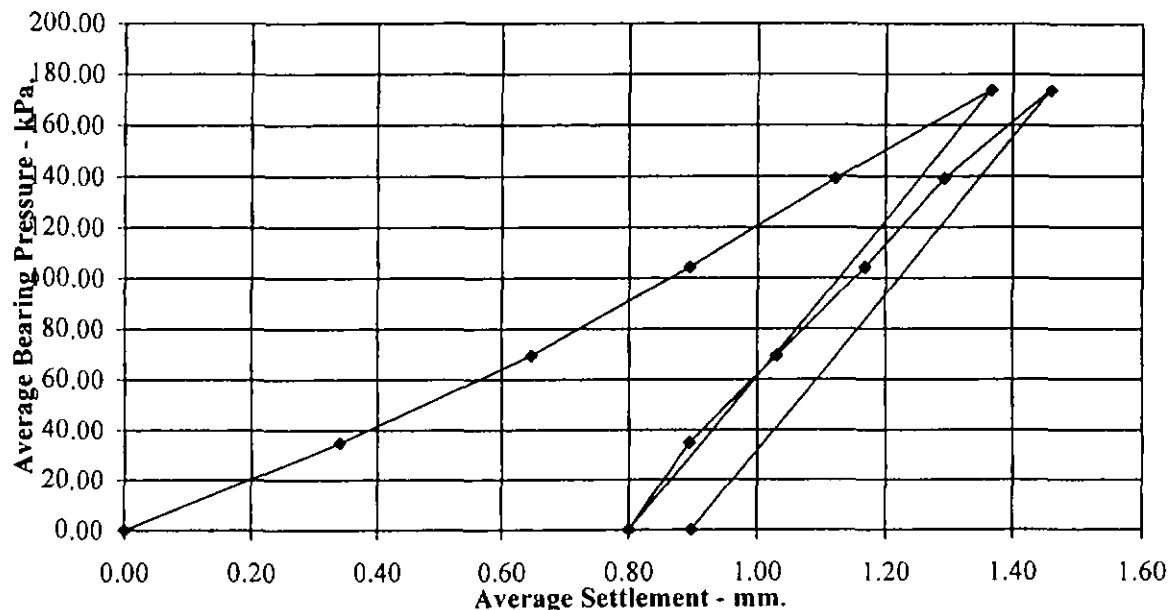
173.76

Maximum Deformation (mm):

1.46

Description:

6F2.



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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 6

Engineer: MJC

Test Position: Rd 3 70m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.52	mm
Settlement at end of reload loop:	1.14	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.62	mm
Reload settlement < 1.27mm; K =	187	kPa
Correction for plate diameter; K _{mod} =	149	kPa
Subgrade CBR =	46	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K / 52) - 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT6-RD3-70 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

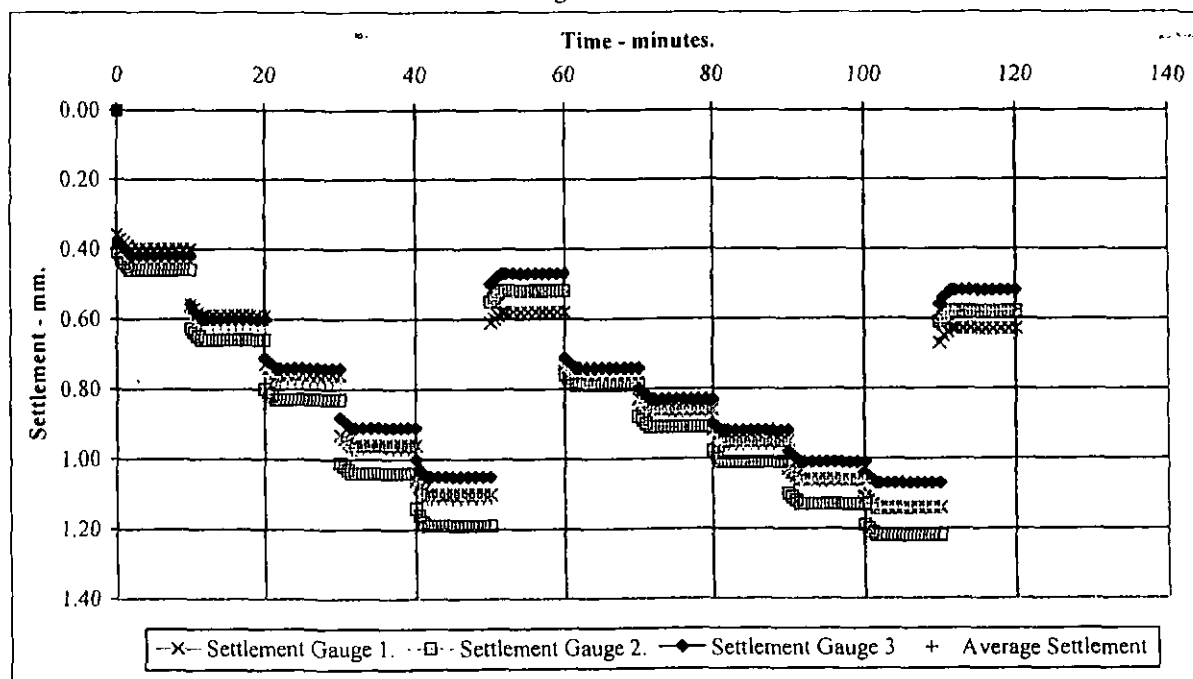
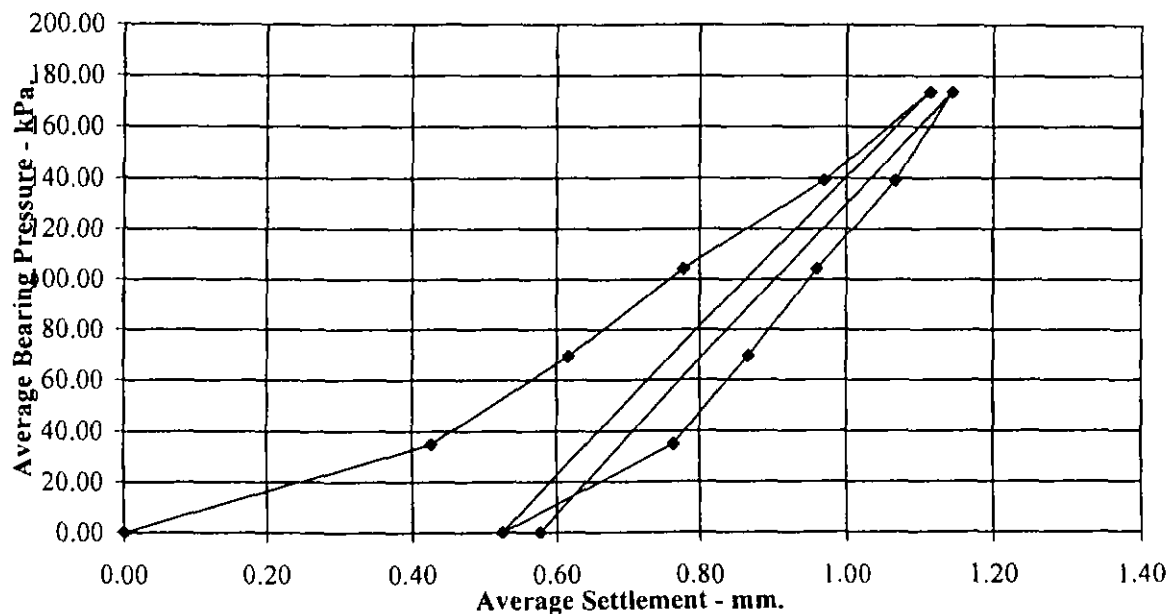
173.76

Maximum Deformation (mm):

1.14

Description:

Type 1



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GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **7**

Engineer: **MJC**

Test Position: **Rd 3 95m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.98	mm
Settlement at end of reload loop:	1.84	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.86	mm
Reload settlement < 1.27mm; K =	135	kPa
Correction for plate diameter; K_{mod} =	108	kPa
Subgrade CBR =	30	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \cdot 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT7-RD3-95 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

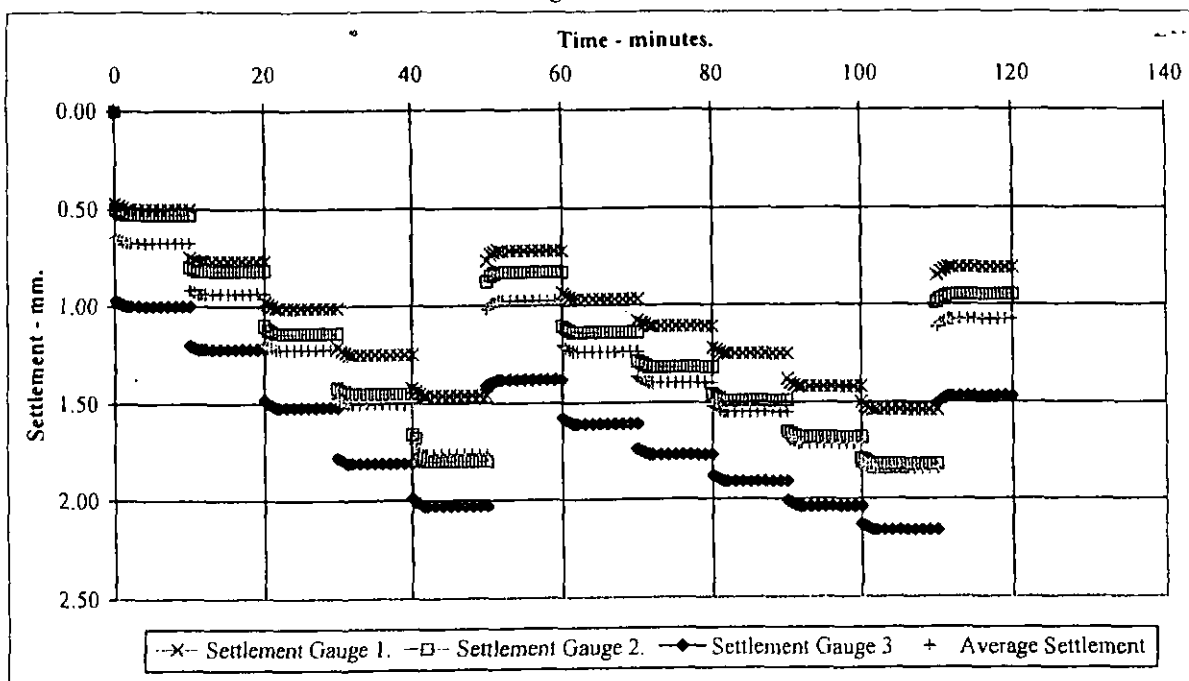
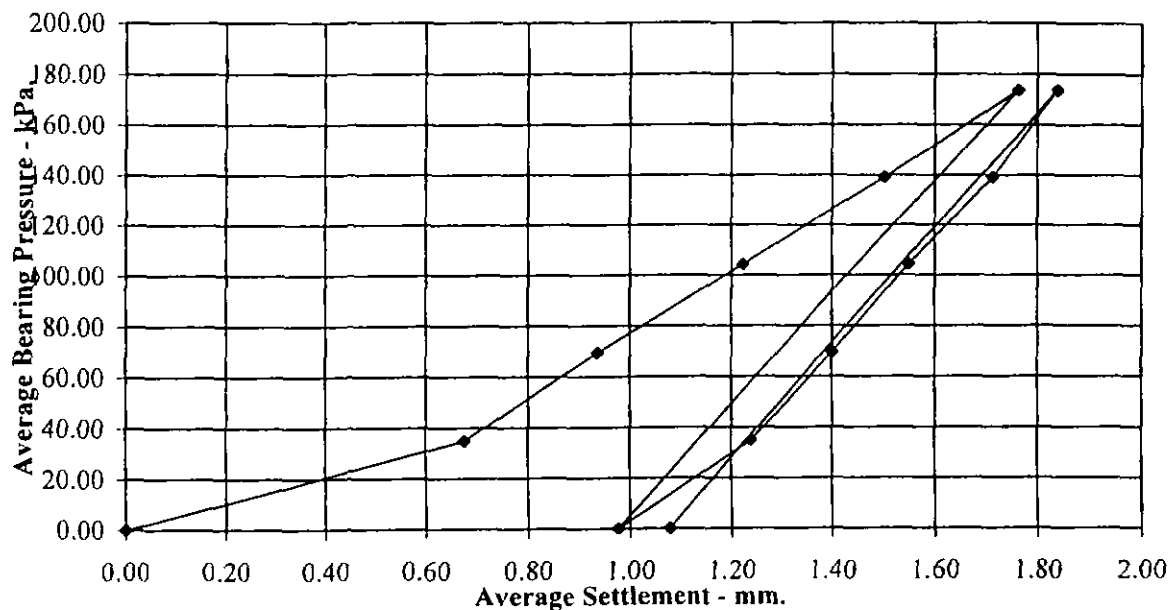
173.76

Maximum Deformation (mm):

1.84

Description:

Type 1



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **8**

Engineer: **MJC**

Test Position: **Rd 3 120m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.20	mm
Settlement at end of reload loop:	2.01	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.81	mm
Reload settlement < 1.27mm; K =	143	kPa
Correction for plate diameter; K _{mod} =	114	kPa
Subgrade CBR =	32	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade (K > 67kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade (K < 67kPa), $CBR = 10^{((K \times 2) / 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT8-RD3-120 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

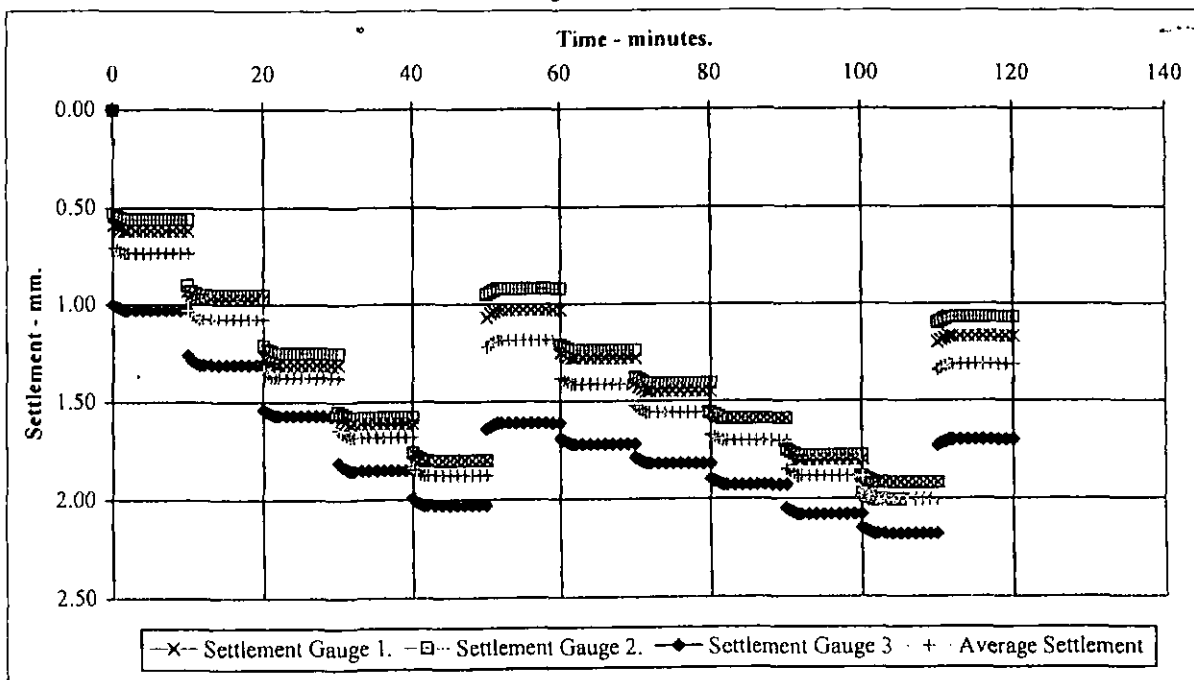
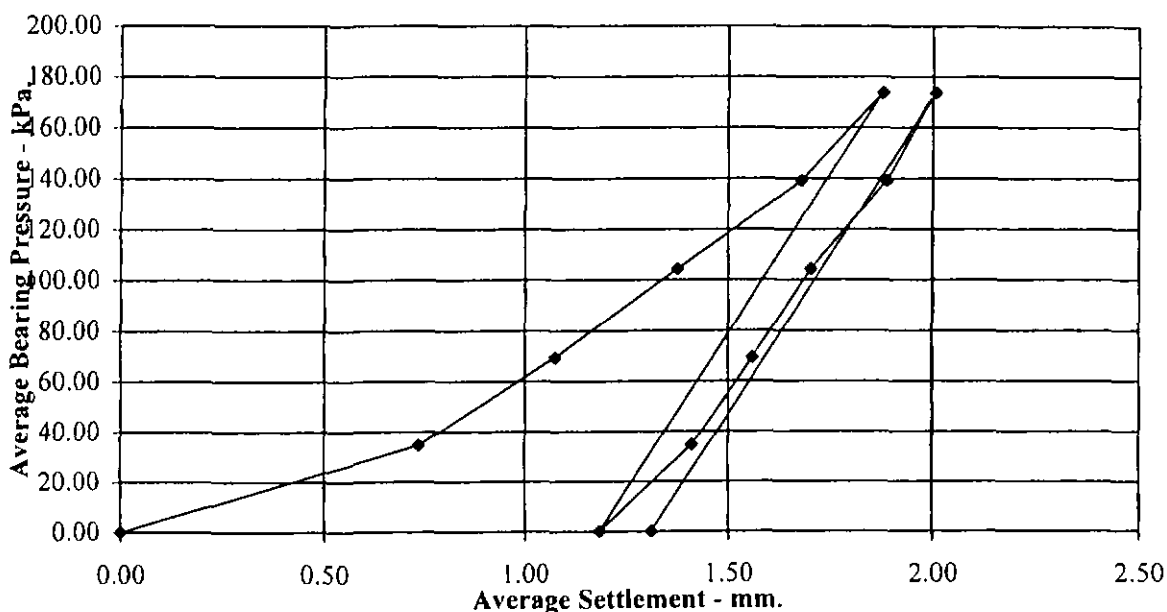
173.76

Maximum Deformation (mm):

2.01

Description:

Type 1



—X— Settlement Gauge 1. —□— Settlement Gauge 2. —◆— Settlement Gauge 3. + Average Settlement

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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **9**

Engineer: **MJC**

Test Position: **Rd 3 145m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.81	mm
Settlement at end of reload loop:	1.69	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.88	mm
Reload settlement < 1.27mm; K =	132	kPa
Correction for plate diameter; K_{mod} =	105	kPa
Subgrade CBR =	29	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT9-RD3-145 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

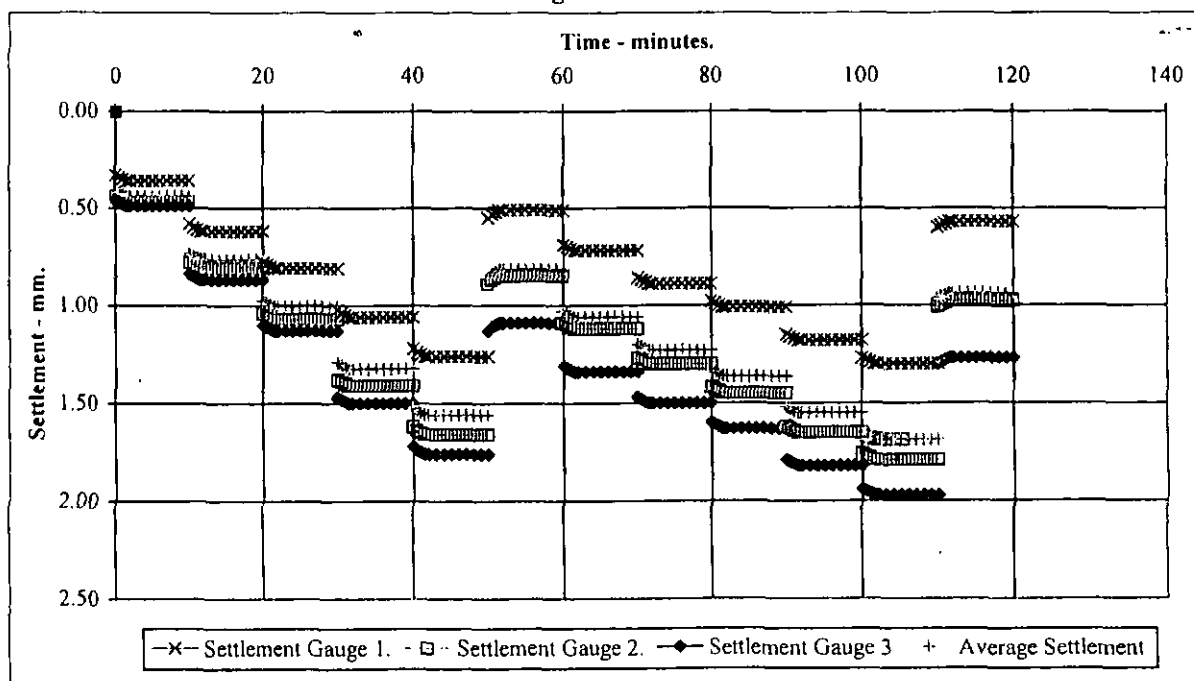
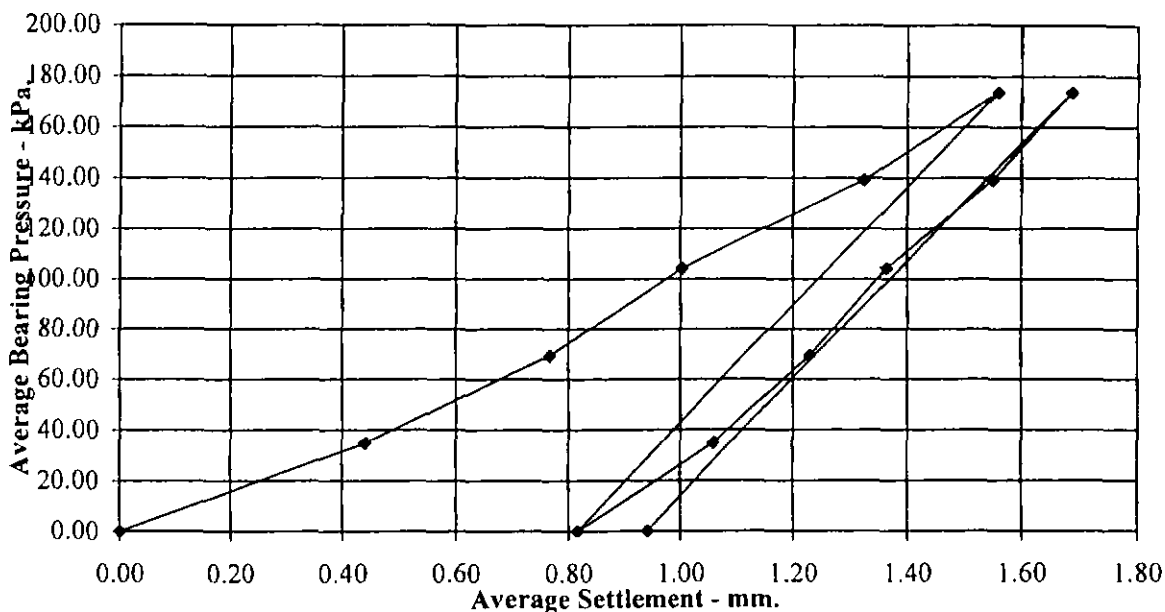
173.76

Maximum Deformation (mm):

1.69

Description:

Type 1



—x— Settlement Gauge 1. —□— Settlement Gauge 2. —♦— Settlement Gauge 3. + Average Settlement

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GOLDTHORPE COLLIERY

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **10**

Engineer: **MJC**

Test Position: **Rd 3 190m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.60	mm
Settlement at end of reload loop:	2.94	mm
Pressure (p) for reload settlement of 1.27mm:	165	kPa

Calculation

Total reload settlement:	1.34	mm
Reload settlement > 1.27mm; K =	87	kPa
Correction for plate diameter; K_{mod} =	69	kPa
Subgrade CBR =	21	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT10-RD3-190 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

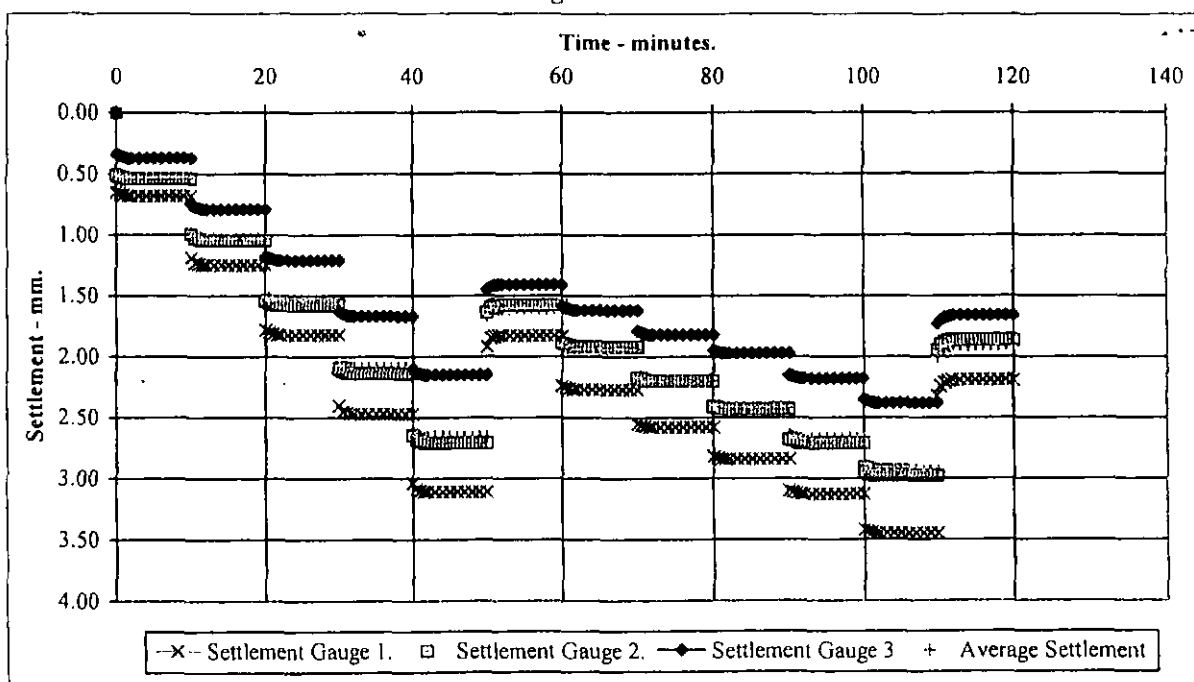
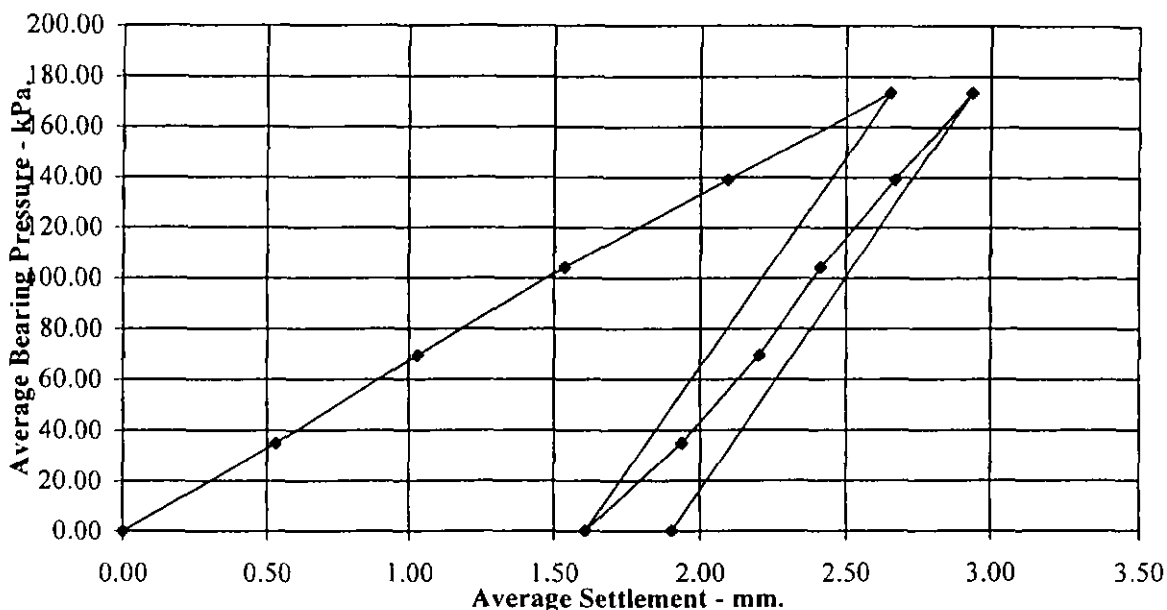
173.76

Maximum Deformation (mm):

2.94

Description:

Type 1



-x- Settlement Gauge 1. □ Settlement Gauge 2. ◆ Settlement Gauge 3 + Average Settlement

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GOLDTHORPE COLLIERY

Client Ref.

Calculation of CBR value from Plate Bearing Test results

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Engineering and Construction
 Inspection and Analysis

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **11**

Engineer: **MJC**

Test Position: **Rd 2 35m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.40	mm
Settlement at end of reload loop:	2.51	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	1.11	mm
Reload settlement < 1.27mm; K =	105	kPa
Correction for plate diameter; K_{mod} =	84	kPa
Subgrade CBR =	23	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
 For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
 For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT11-RD2-35 Mch

Depth (m): Formation Level

 Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

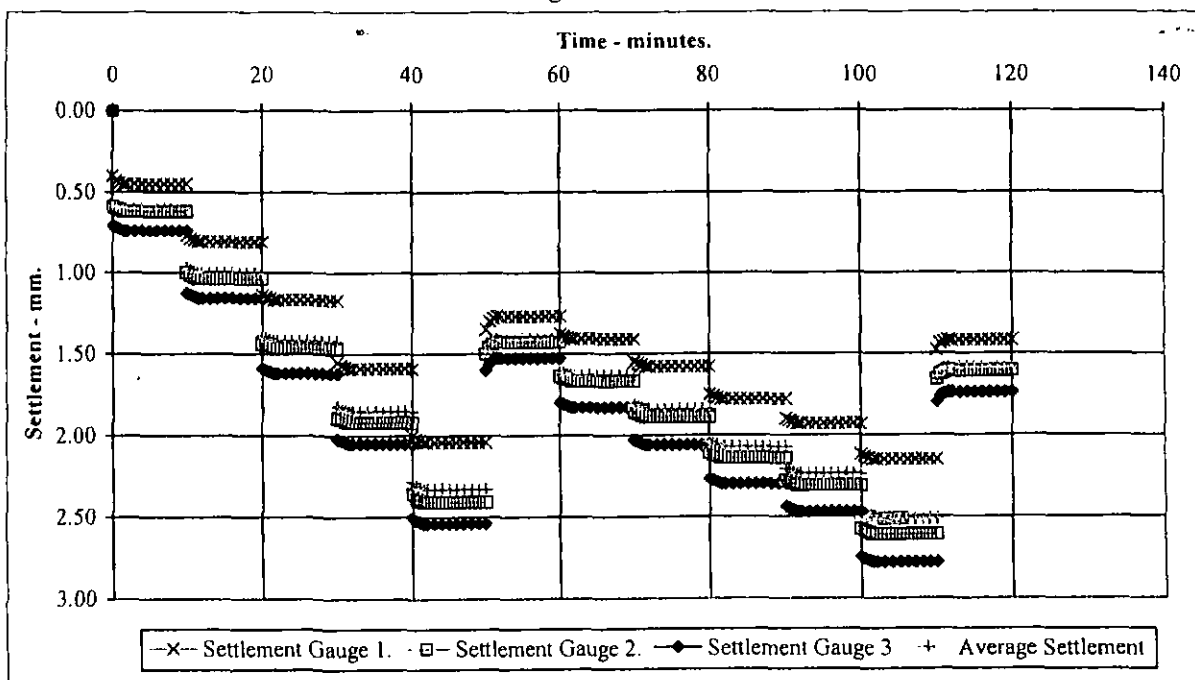
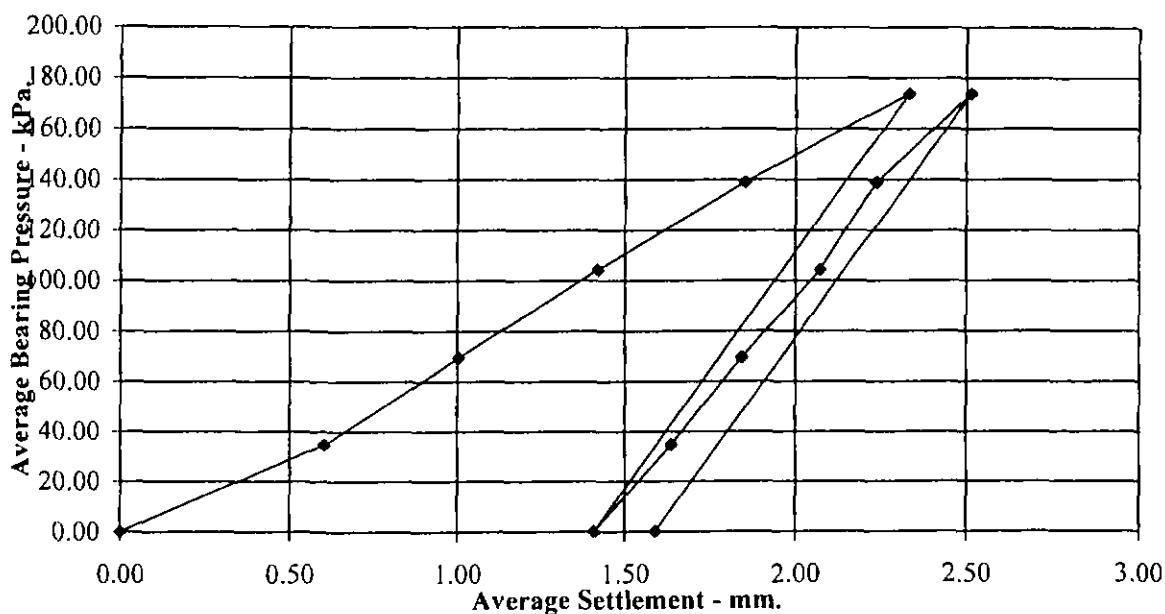
173.76

Maximum Deformation (mm):

2.51

Description:

Type 1



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GOLDTHORPE COLLIERY

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **12**

Engineer: **MJC**

Test Position: **Rd 14 35m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.57	mm
Settlement at end of reload loop:	2.82	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	1.25	mm
Reload settlement < 1.27mm; K =	93	kPa
Correction for plate diameter; K _{mod} =	74	kPa
Subgrade CBR =	21	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 17-May-06

Test Position: 12. Rd 14, 35 mch

Depth (m): Formation Level

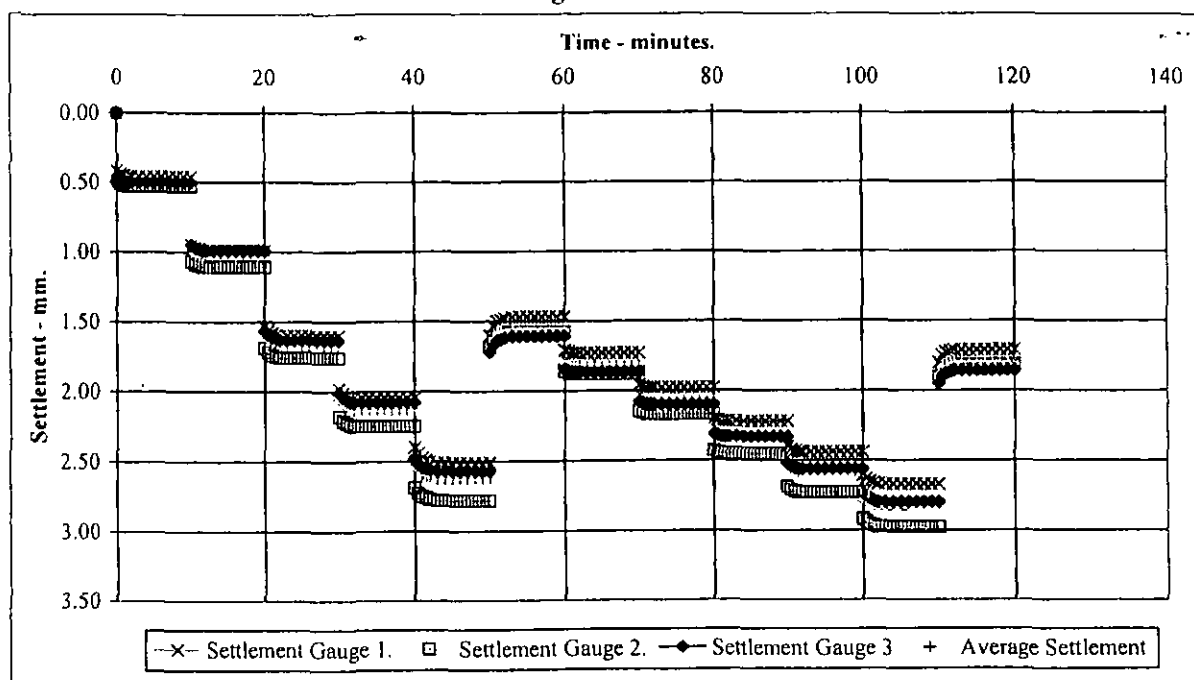
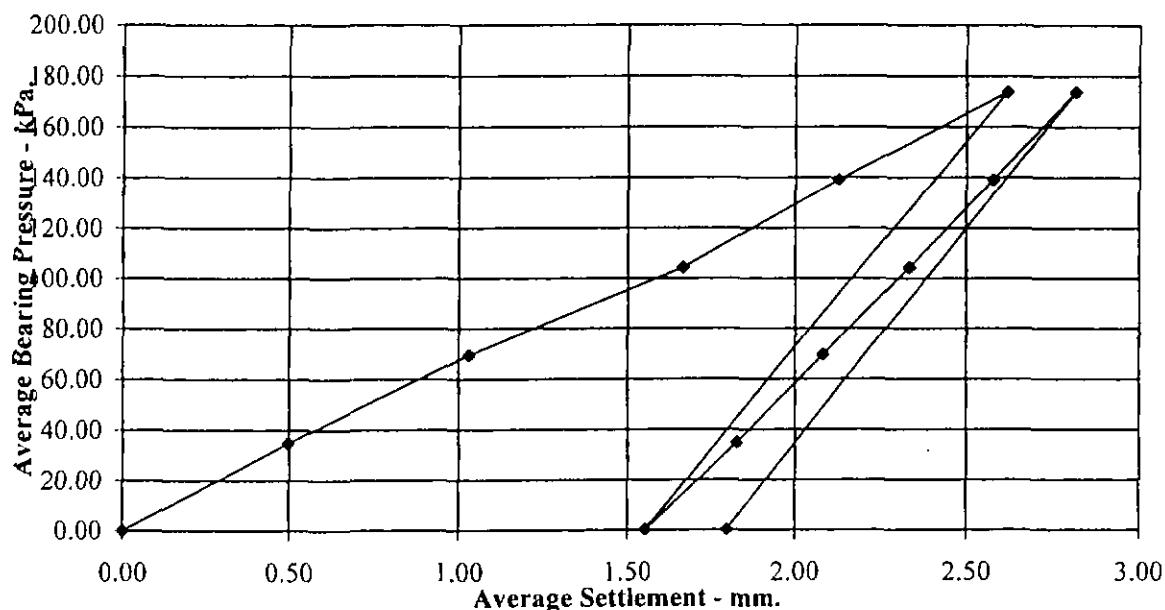
Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa): 173.76

Maximum Deformation (mm): 2.82

Description: 6F2



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GOLDTHORPE COLLIERY

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Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **13**

Engineer: **MJC**

Test Position: **Rd 3 0m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.64	mm
Settlement at end of reload loop:	2.65	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	1.01	mm
Reload settlement < 1.27mm; K =	115	kPa
Correction for plate diameter; K _{mod} =	92	kPa
Subgrade CBR =	25	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K \times 52) / 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 27-Apr-06

Test Position: PBT13-RD3-0 Mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

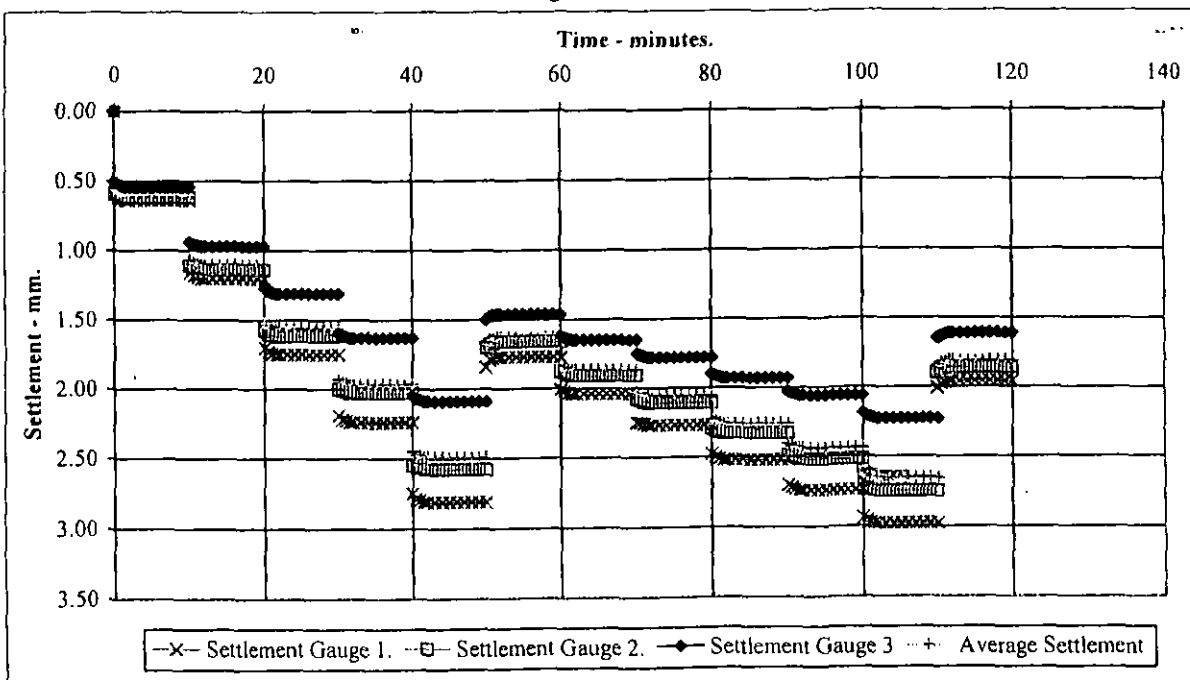
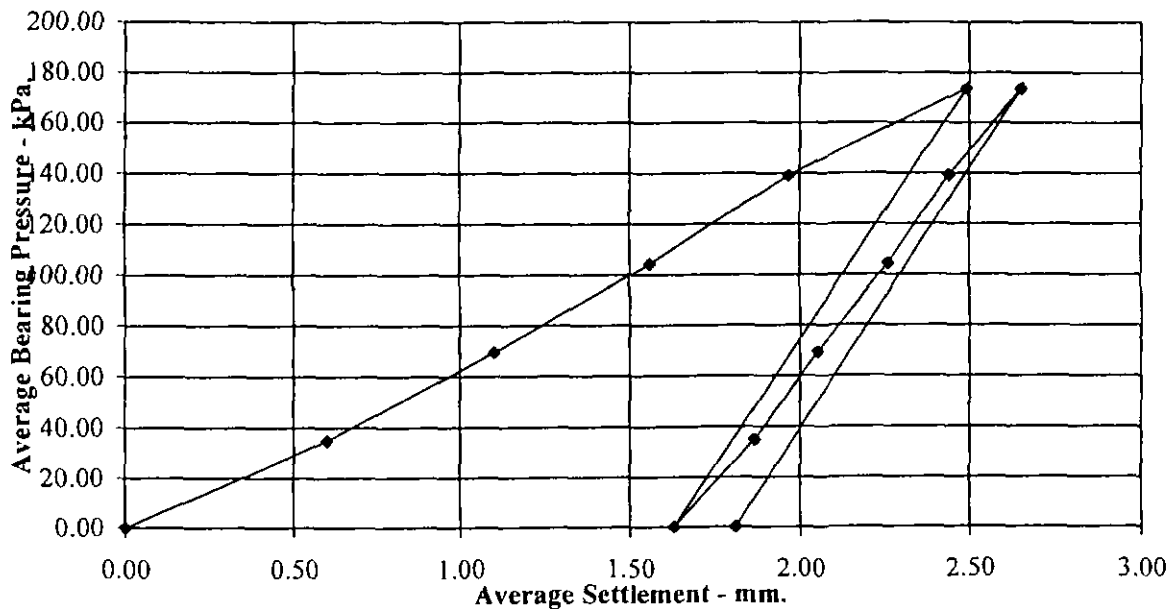
173.76

Maximum Deformation (mm):

2.65

Description:

Type 1



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **14**

Engineer: **MJC**

Test Position: **Rd 3 215m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.06	mm
Settlement at end of reload loop:	1.64	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.58	mm
Reload settlement < 1.27mm; K =	200	kPa
Correction for plate diameter; K_{mod} =	160	kPa
Subgrade CBR =	51	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{(K+224)/225}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/52.49)}$

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25061

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Doncaster, DN4 0AG
tel: 0870 2401964 . fax: 0870 2401965
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VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 14 Rd 3

Depth (m): Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

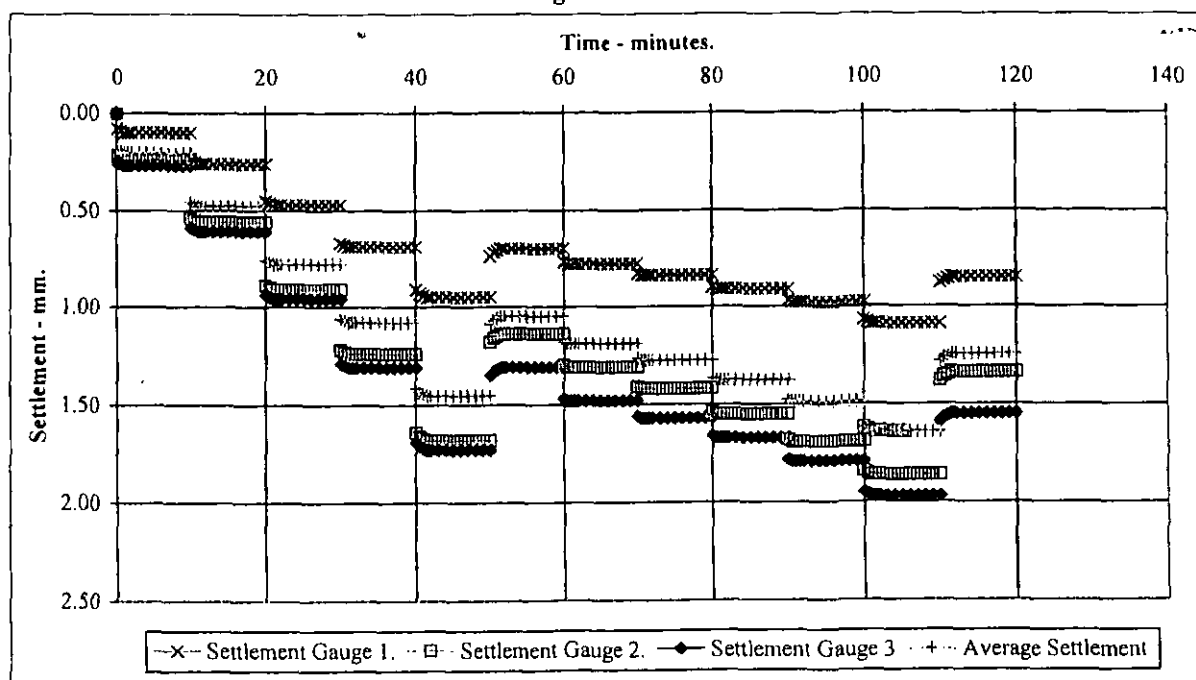
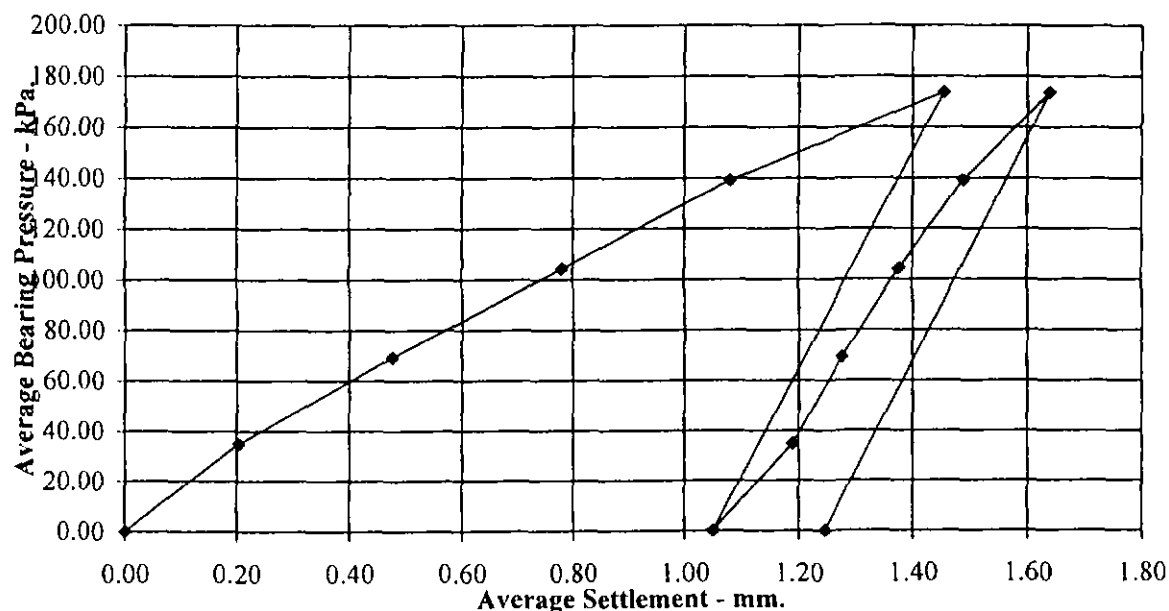
173.76

Maximum Deformation (mm):

1.64

Description:

6F2



--X-- Settlement Gauge 1. --□-- Settlement Gauge 2. --◆-- Settlement Gauge 3. --+-- Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **15**

Engineer: **MJC**

Test Position: **Rd 3 250m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter: **600** mm
 Settlement at start of reload loop: **0.32** mm
 Settlement at end of reload loop: **0.67** mm
 Maximum test pressure (p): **174** kPa

Calculation

Total reload settlement: **0.35** mm
 Reload settlement < 1.27mm; K = **331** kPa
 Correction for plate diameter; K_{mod} = **265** kPa

 Subgrade CBR = **149** %

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
 For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
 For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 15 Rd 3

Depth (m): Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

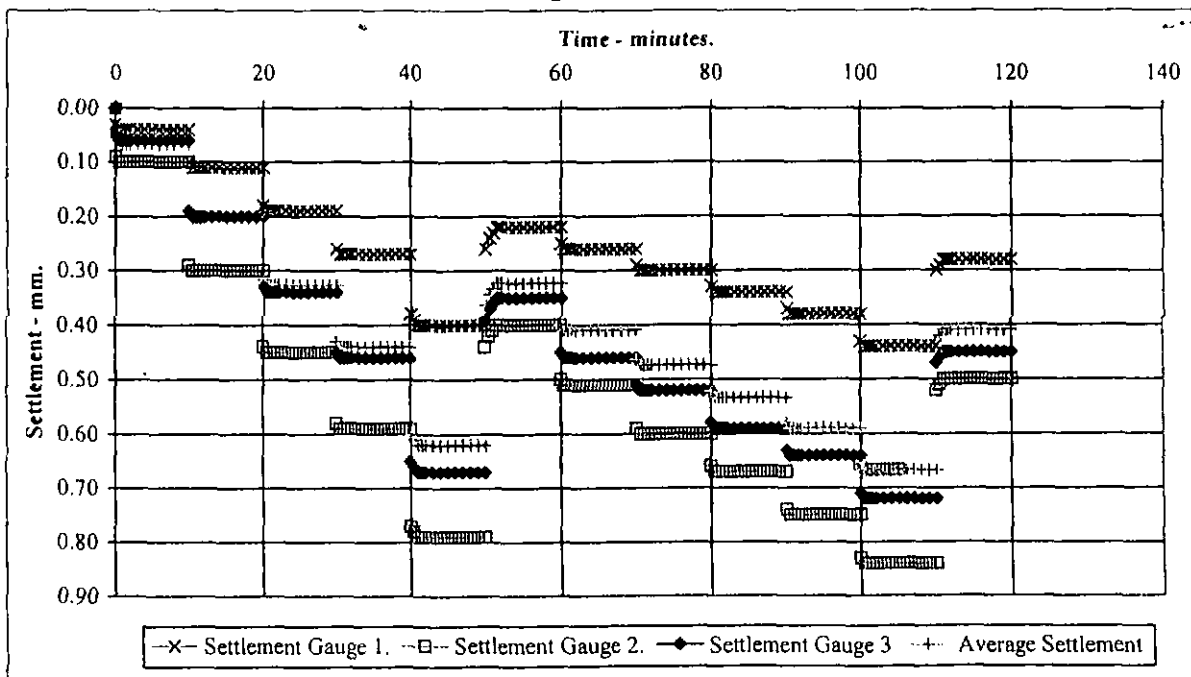
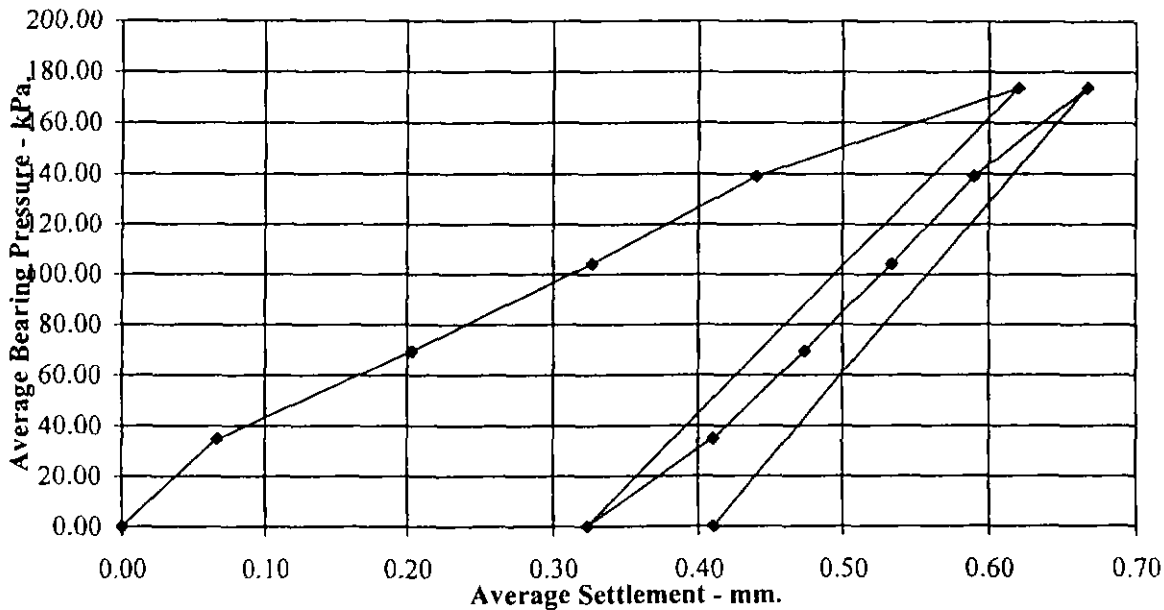
173.76

Maximum Deformation (mm):

0.67

Description:

6F2



--x-- Settlement Gauge 1. --□-- Settlement Gauge 2. --◆-- Settlement Gauge 3. --+-- Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **16**

Engineer: **MJC**

Test Position: **Rd 3 285m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.95	mm
Settlement at end of reload loop:	1.83	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.88	mm
Reload settlement < 1.27mm; K =	132	kPa
Correction for plate diameter; K_{mod} =	105	kPa
Subgrade CBR =	29	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K / 52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 16 Rd 3

Depth (m):

Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

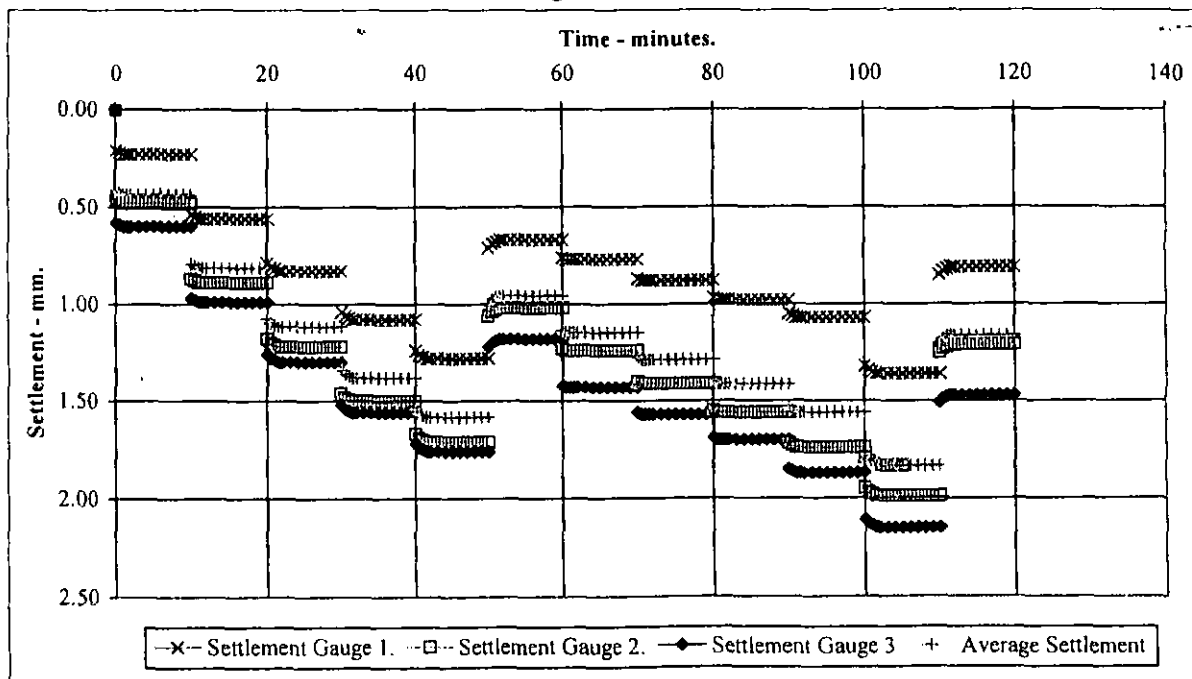
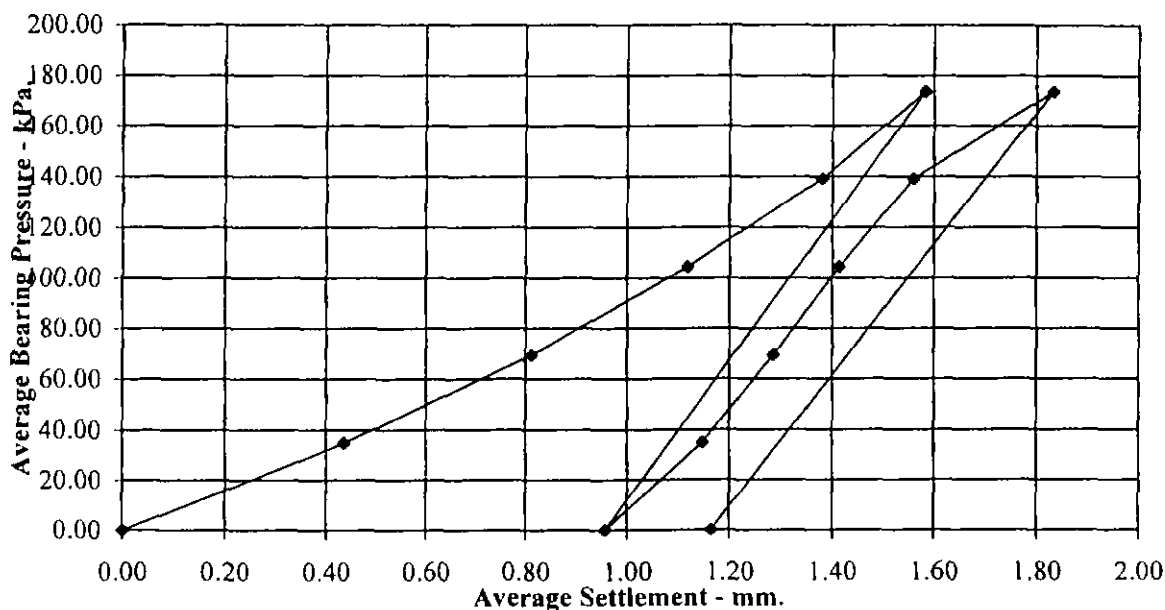
173.76

Maximum Deformation (mm):

1.83

Description:

6F2



—x— Settlement Gauge 1. —□— Settlement Gauge 2. —◆— Settlement Gauge 3. + Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **17**

Engineer: **MJC**

Test Position: **Rd 3 305m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.05	mm
Settlement at end of reload loop:	1.72	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.67	mm
Reload settlement < 1.27mm; K =	173	kPa
Correction for plate diameter; K_{mod} =	139	kPa
Subgrade CBR =	41	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K \times 52)/49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 17 Rd 3

Depth (m): Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

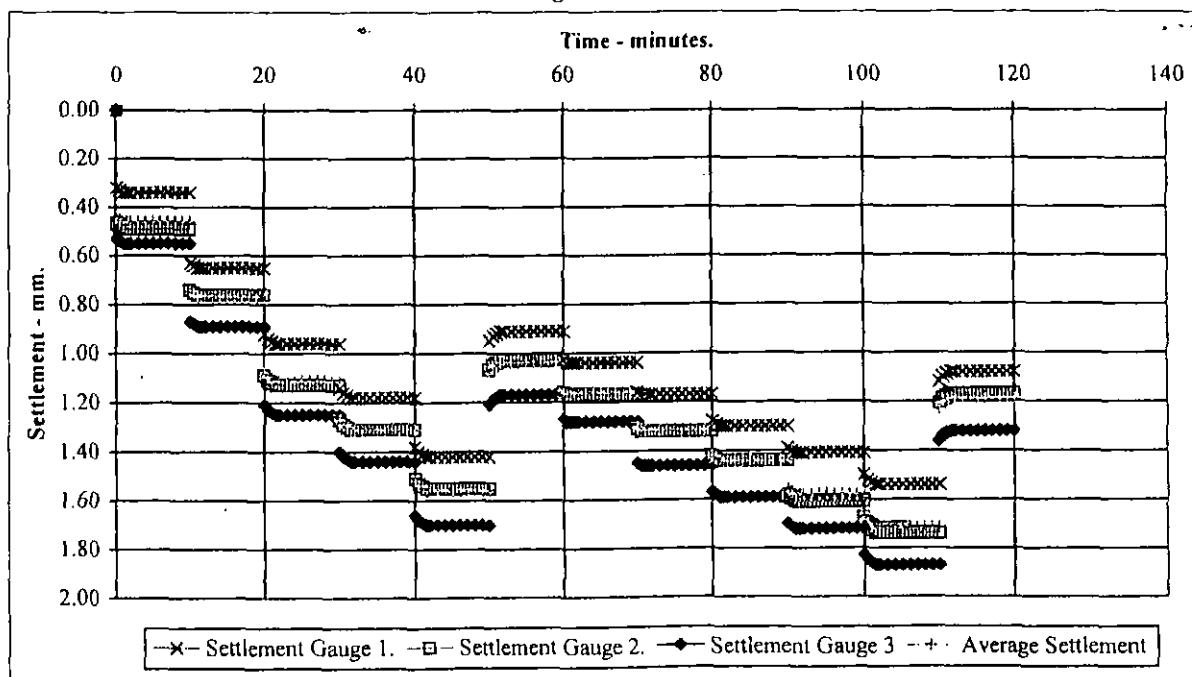
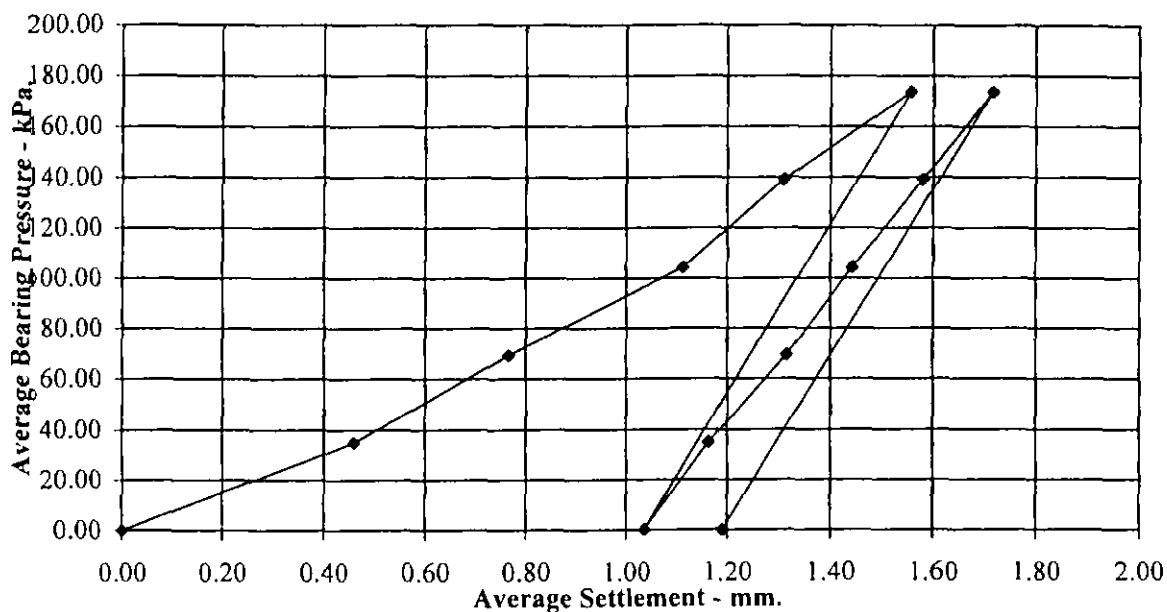
173.76

Maximum Deformation (mm):

1.72

Description:

6F2



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **18**

Engineer: **MJC**

Test Position: **Rd 3 335m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.76	mm
Settlement at end of reload loop:	1.20	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.44	mm
Reload settlement < 1.27mm; K =	264	kPa
Correction for plate diameter; K_{mod} =	211	kPa
Subgrade CBR =	86	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K+224)/225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{(K/52.48)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 18 Rd 3

Depth (m):

Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

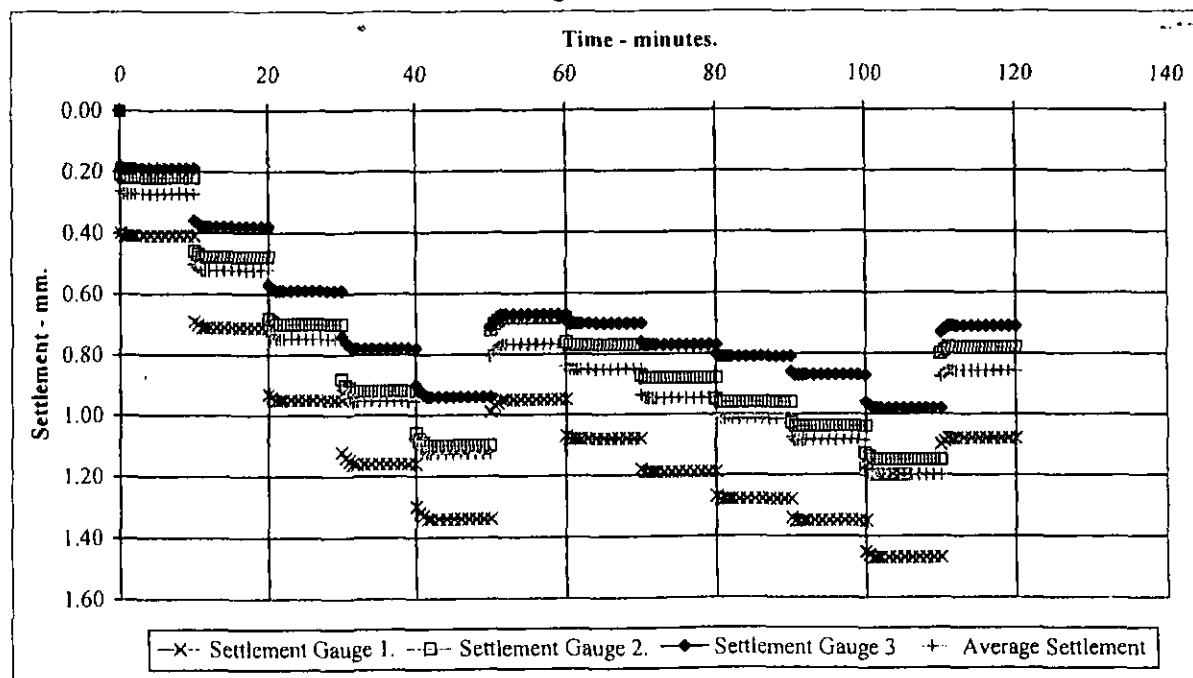
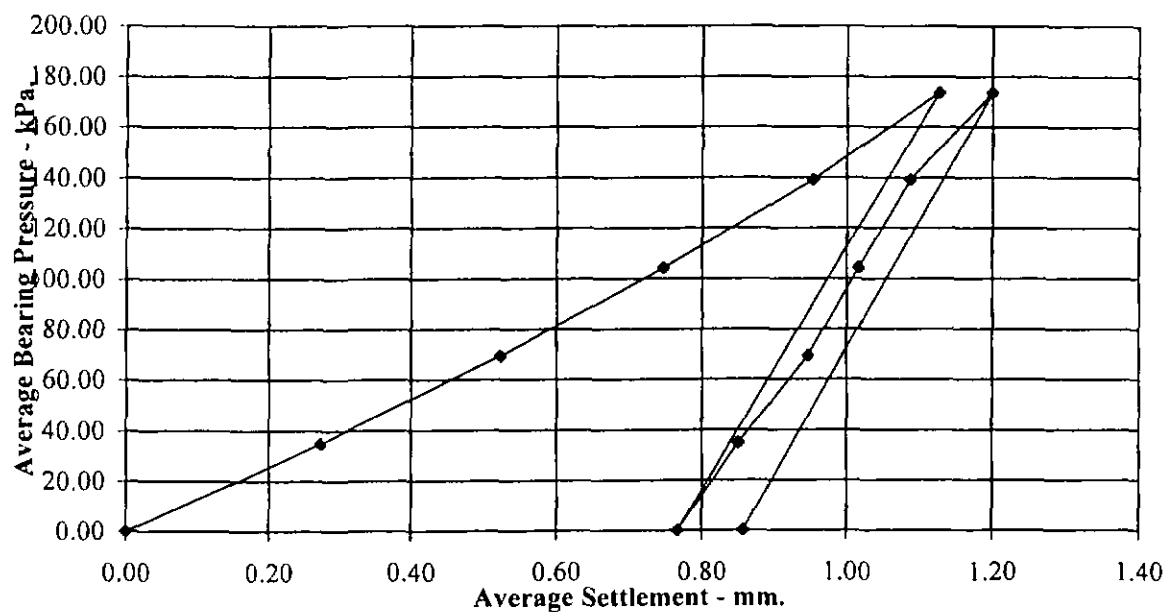
173.76

Maximum Deformation (mm):

1.20

Description:

6F2



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 19

Engineer: MJC

Test Position: Rd 4 10m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.63	mm
Settlement at end of reload loop:	1.26	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.63	mm
Reload settlement < 1.27mm; K =	184	kPa
Correction for plate diameter; K _{mod} =	147	kPa
Subgrade CBR =	45	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 03-May-06

Test Position: 19 Rd 4

Depth (m):

Finished Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

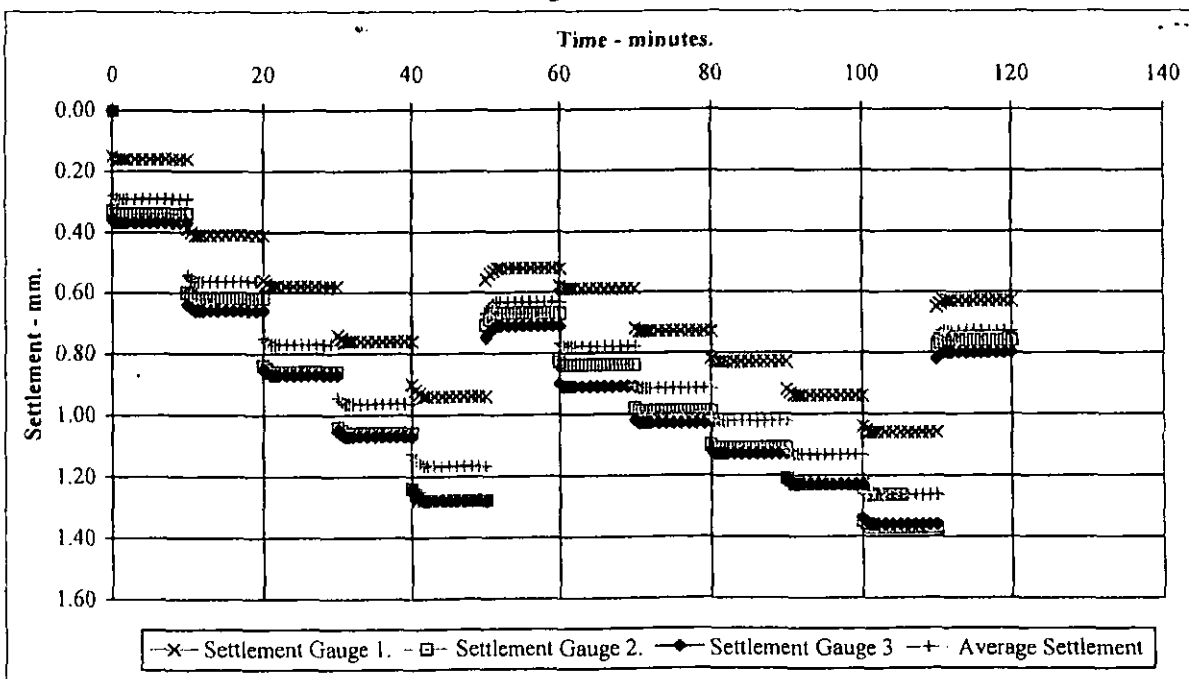
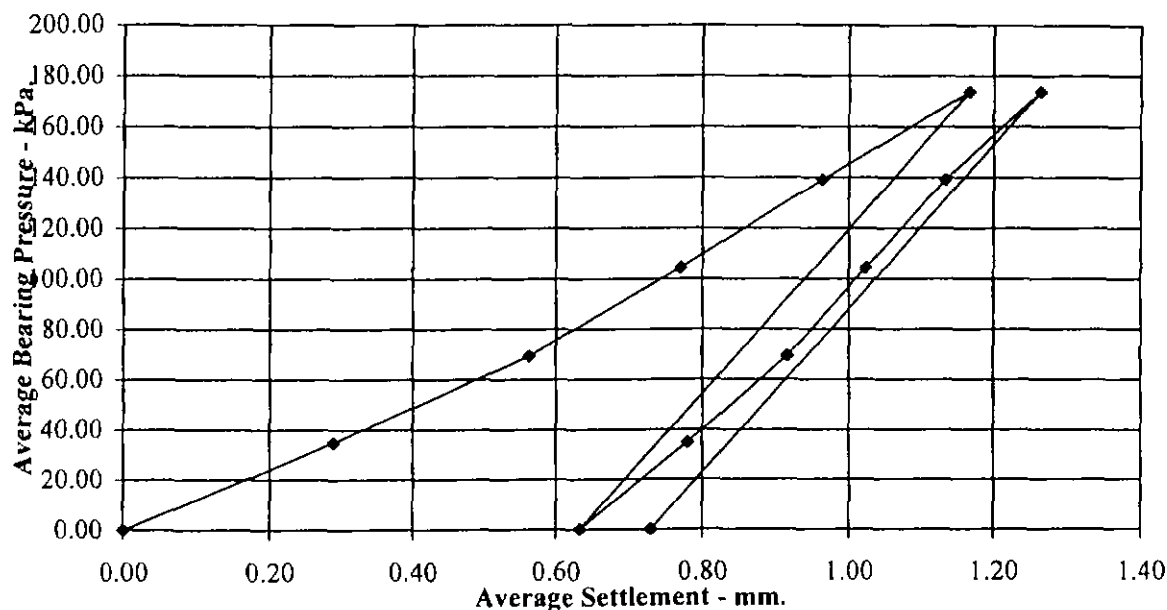
173.76

Maximum Deformation (mm):

1.26

Description:

6F2



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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **20**

Engineer: **MJC**

Test Position: **Rd 5 40m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.77	mm
Settlement at end of reload loop:	1.59	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.82	mm
Reload settlement < 1.27mm; K =	141	kPa
Correction for plate diameter; K _{mod} =	113	kPa
Subgrade CBR =	32	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K \times 52) / 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 10-May-06

Test Position: 20 Rd 5 40 mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

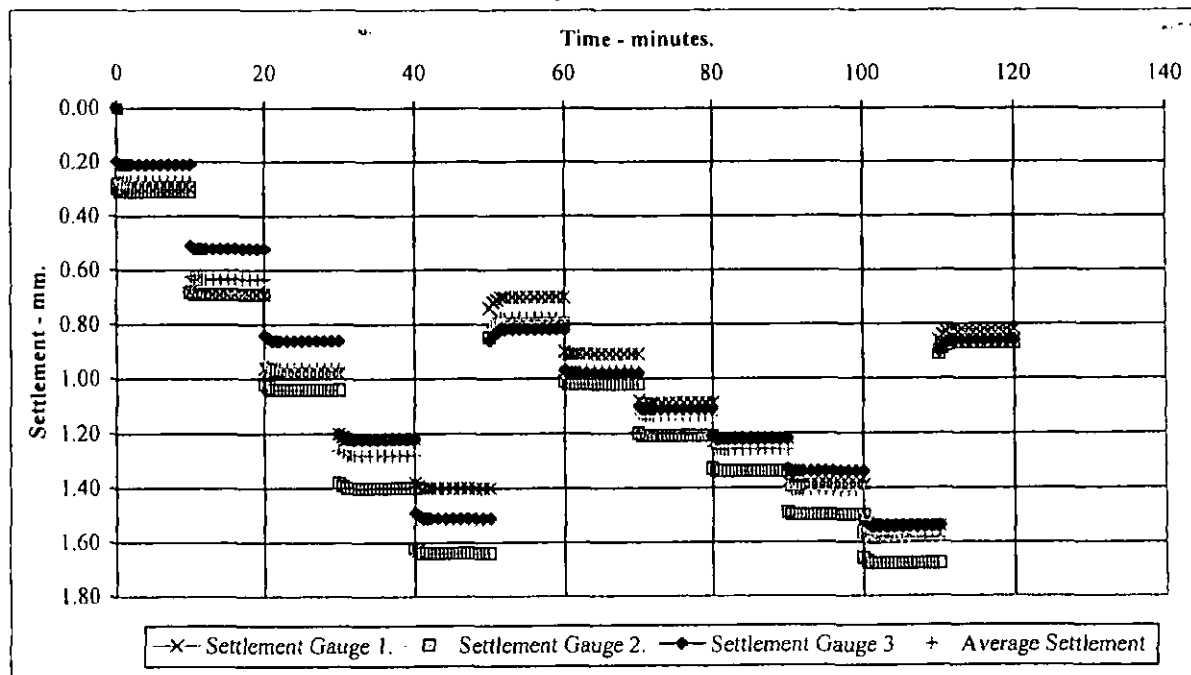
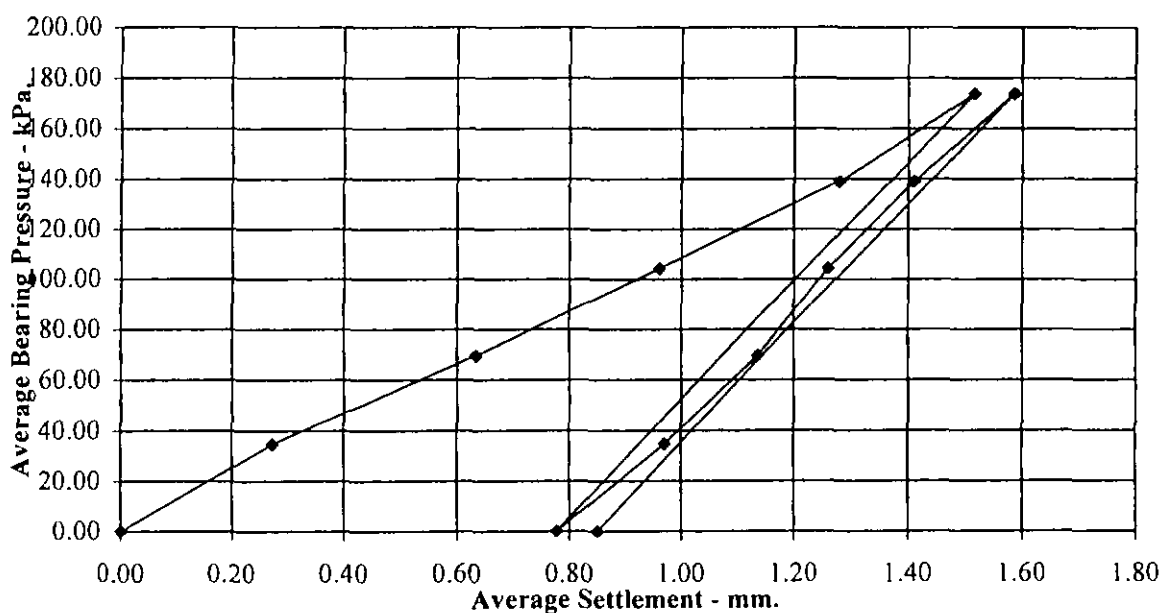
173.76

Maximum Deformation (mm):

1.59

Description:

6F2.



—x— Settlement Gauge 1. —□— Settlement Gauge 2. —◆— Settlement Gauge 3. + Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **21**

Engineer: **MJC**

Test Position: **Rd 5 100m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.46	mm
Settlement at end of reload loop:	2.37	mm
Maximum test pressure (p):	165	kPa

Calculation

Total reload settlement:	0.91	mm
Reload settlement < 1.27mm; K =	121	kPa
Correction for plate diameter; K _{mod} =	97	kPa
Subgrade CBR =	27	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K / 52) \times 40)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 10-May-06

Test Position: 21 Rd 5 100 mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

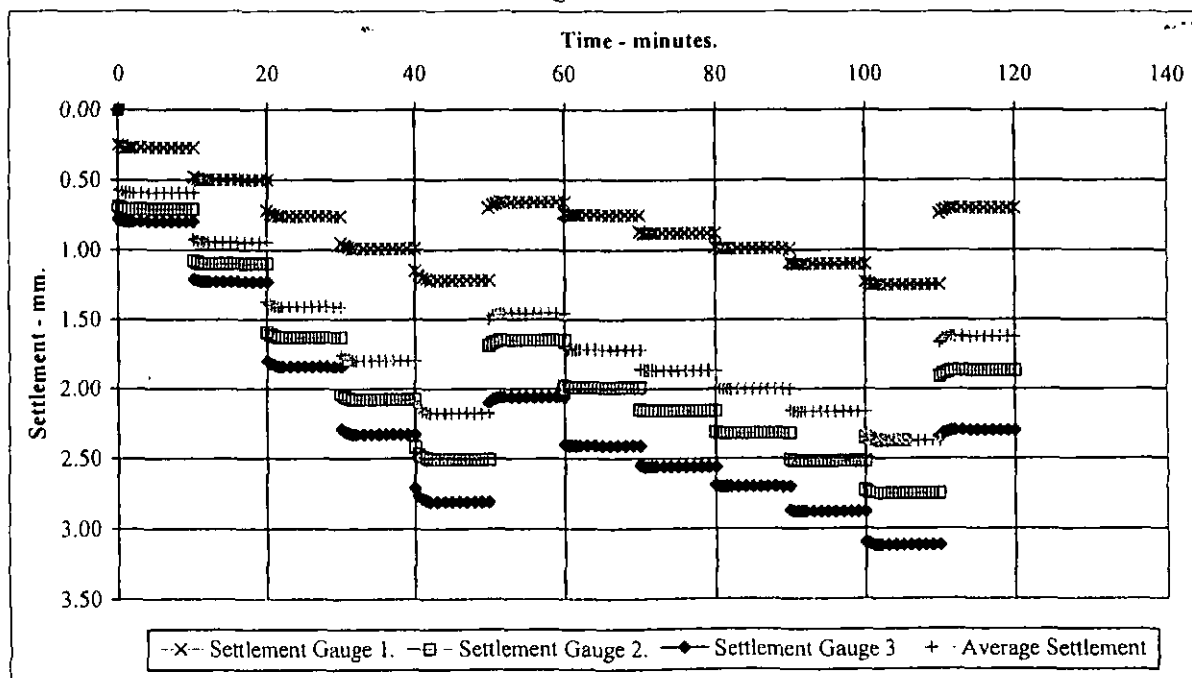
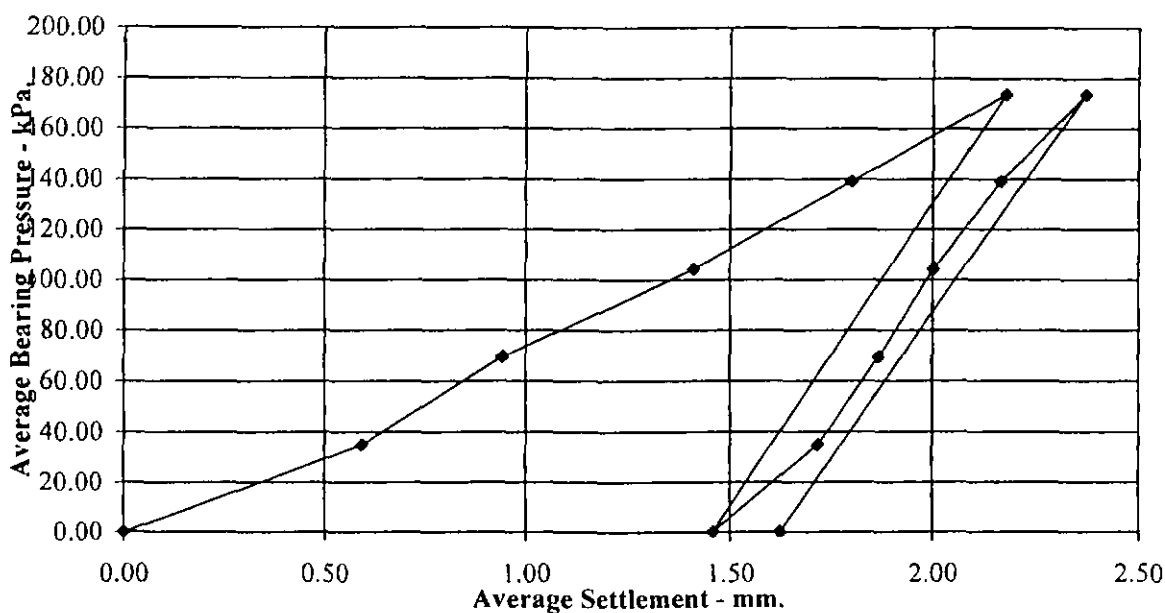
173.76

Maximum Deformation (mm):

2.37

Description:

6F2.



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PSL06/821

GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 22

Engineer: MJC

Test Position: Rd 6 40m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.53	mm
Settlement at end of reload loop:	0.81	mm
Maximum test pressure (p):	165	kPa

Calculation

Total reload settlement:	0.28	mm
Reload settlement < 1.27mm; K =	393	kPa
Correction for plate diameter; K _{mod} =	314	kPa
Subgrade CBR =	247	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K / 52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 10-May-06

Test Position: 22 Rd 6 40 mch

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

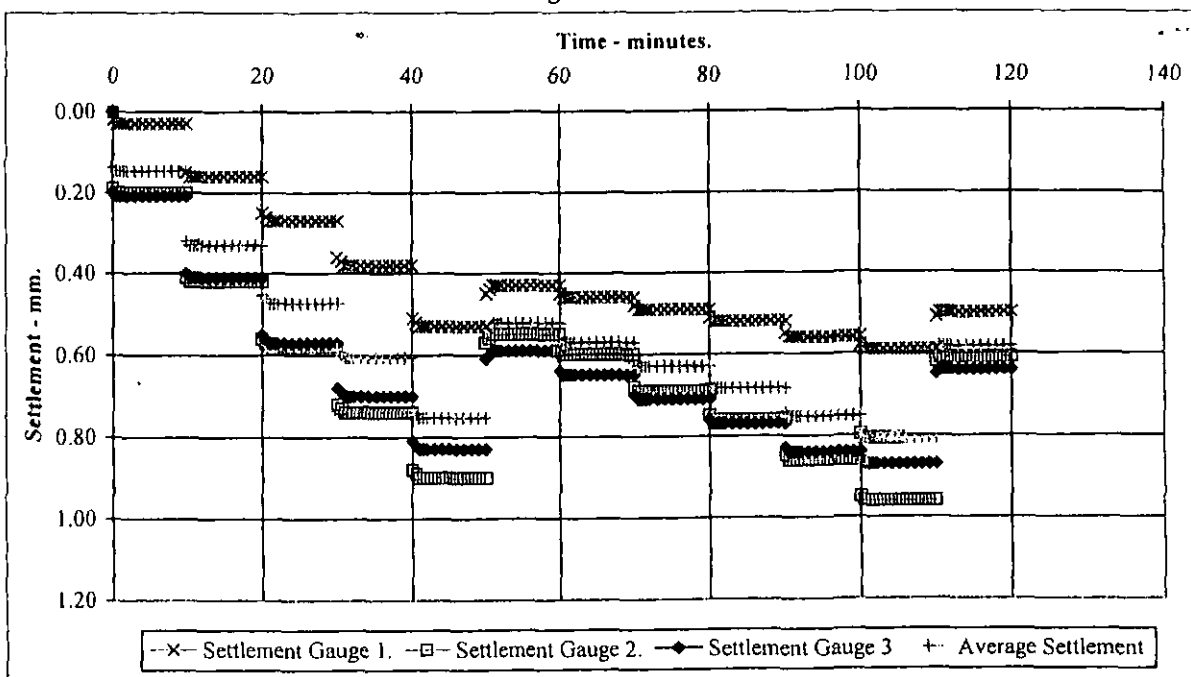
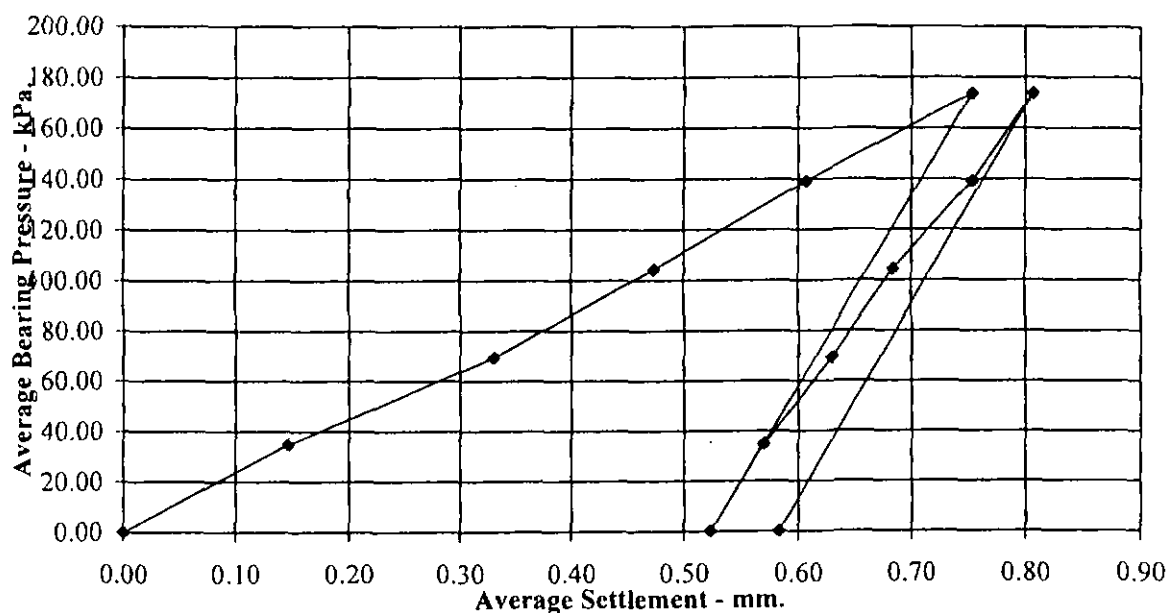
173.76

Maximum Deformation (mm):

0.81

Description:

6F2.



Compiled By

Date

Checked By

Date

Approved By

Date

Contract No.

PSL06/821

GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **23**

Engineer: **MJC**

Test Position: **Rd 3 720m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.34	mm
Settlement at end of reload loop:	2.66	mm
Pressure (p) for reload settlement of 1.27mm:	160	kPa

Calculation

Total reload settlement:	1.32	mm
Reload settlement > 1.27mm; K =	84	kPa
Correction for plate diameter; K_{mod} =	67	kPa
Subgrade CBR =	19	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K+224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52)-49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 23.Rd 3. 720 MCH

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

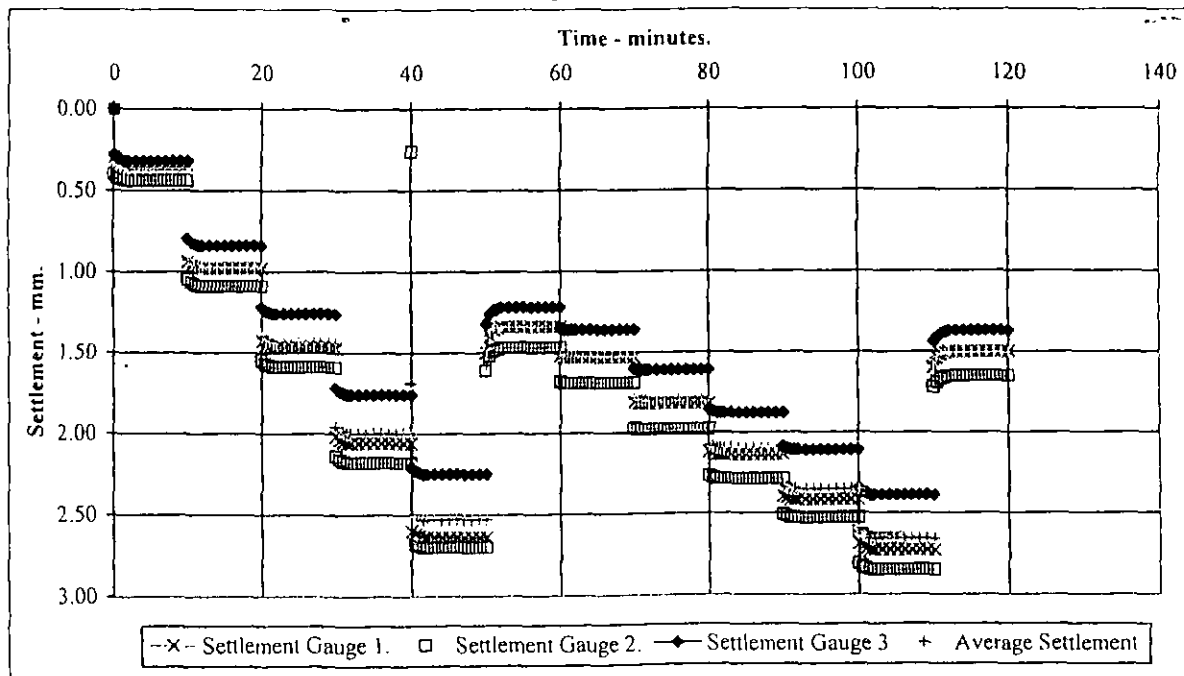
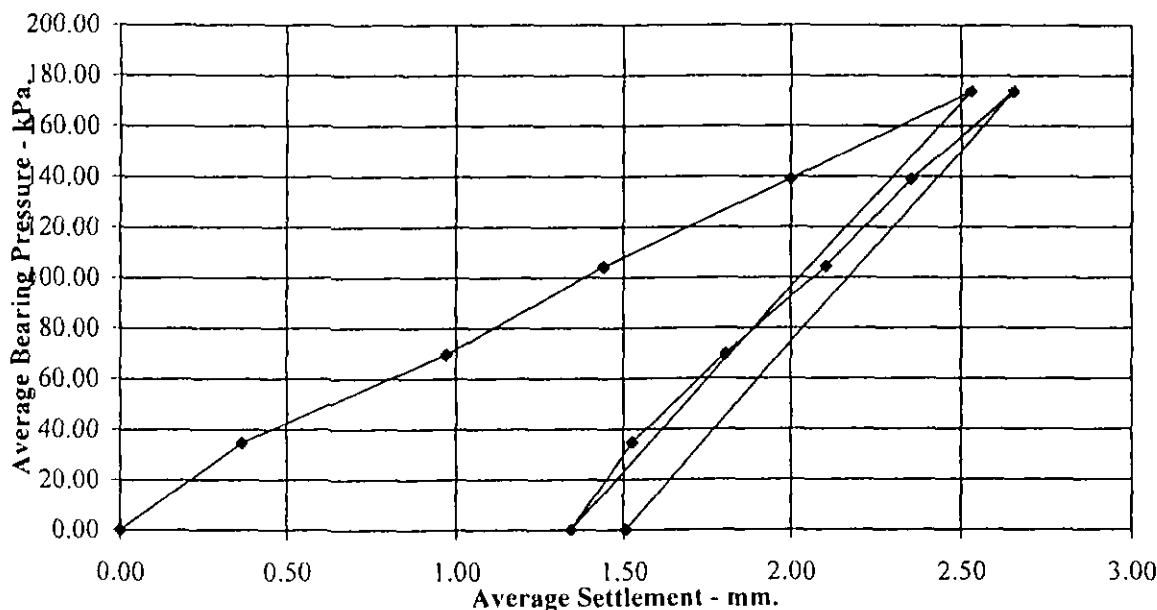
173.76

Maximum Deformation (mm):

2.66

Description:

Crushed Concrete.



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GOLDTHORPE COLLIERY.						Client Ref.
RECEIVED 09 JUN 2006 25218.						

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 24

Engineer: MJC

Test Position: Rd 3 700m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	2.64	mm
Settlement at end of reload loop:	5.30	mm
Pressure (p) for reload settlement of 1.27mm:	100	kPa

Calculation

Total reload settlement:	2.66	mm
Reload settlement > 1.27mm; K =	52	kPa
Correction for plate diameter; K_{mod} =	42	kPa
Subgrade CBR =	6	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 24.Rd 3. 700 MCH

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

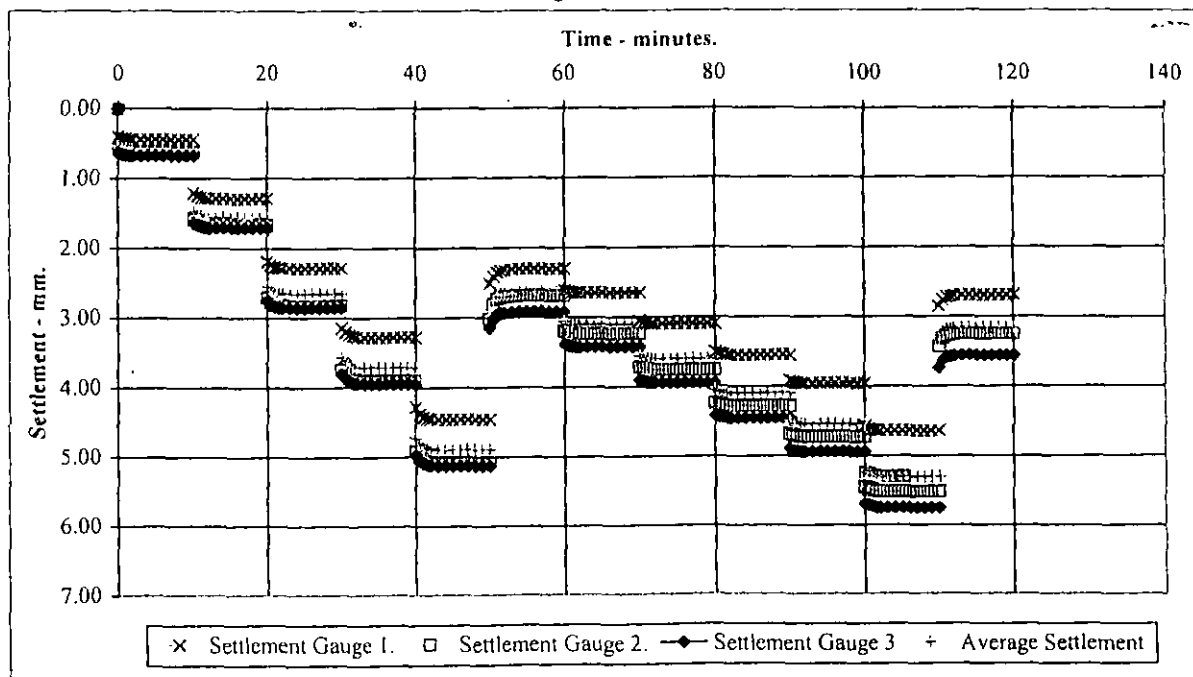
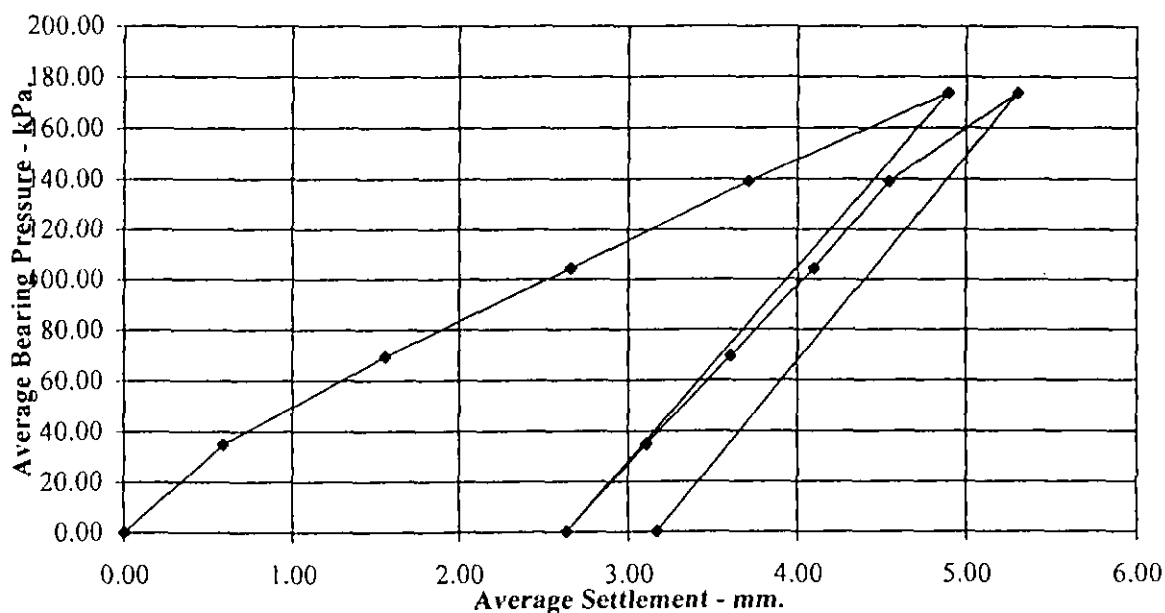
173.76

Maximum Deformation (mm):

5.30

Description:

Crushed Concrete.



× Settlement Gauge 1. □ Settlement Gauge 2. —●— Settlement Gauge 3 + Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **25**

Engineer: **MJC**

Test Position: **Rd 3 685m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.50	mm
Settlement at end of reload loop:	0.96	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.46	mm
Reload settlement < 1.27mm; K =	251	kPa
Correction for plate diameter; K _{mod} =	200	kPa
Subgrade CBR =	77	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K+224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 25.Rd 3. 685 MCII

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

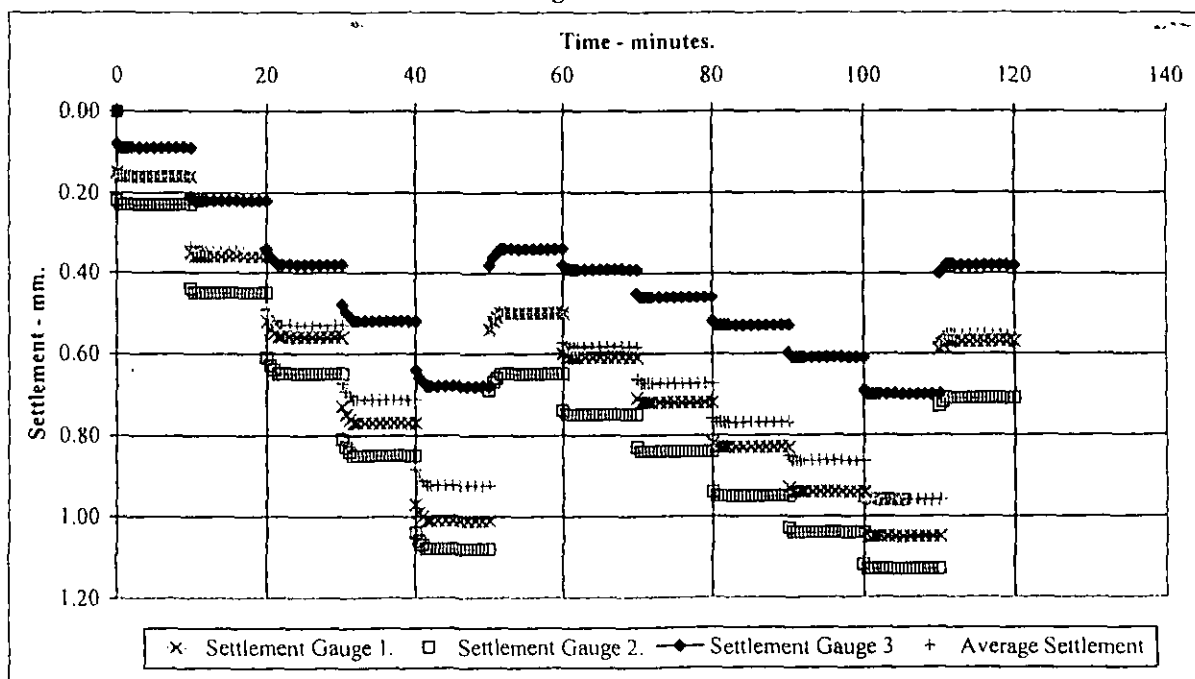
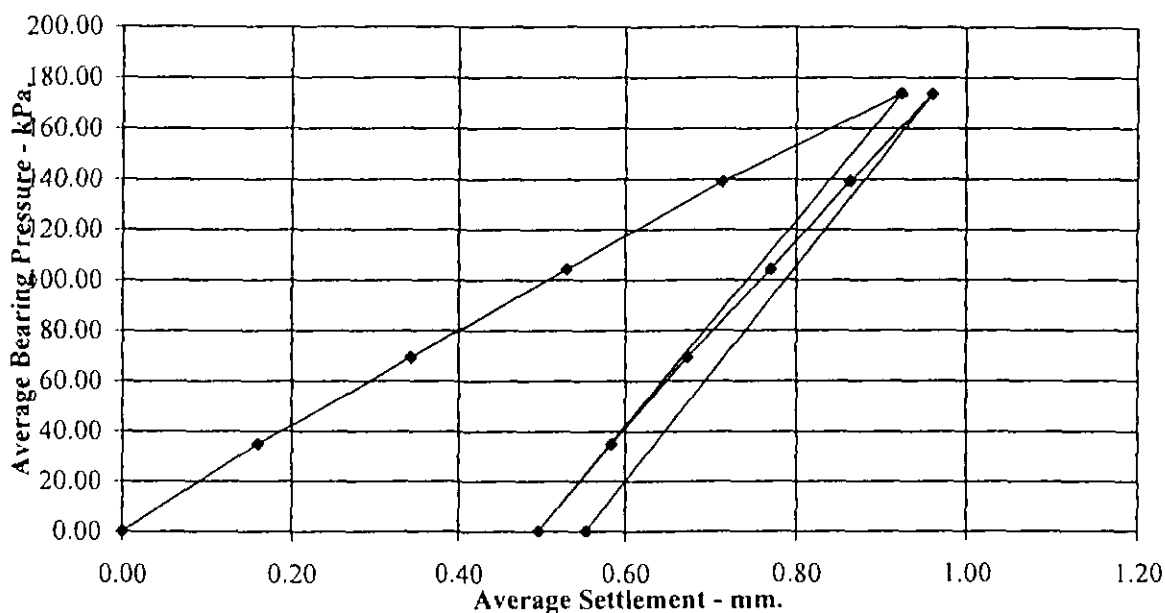
173.76

Maximum Deformation (mm):

0.96

Description:

Crushed Concrete.



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GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 26

Engineer: MJC

Test Position: Rd 13 15m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.83	mm
Settlement at end of reload loop:	1.47	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.64	mm
Reload settlement < 1.27mm; K =	180	kPa
Correction for plate diameter; K_{mod} =	144	kPa
Subgrade CBR =	43	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 22.4)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/32.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 26

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

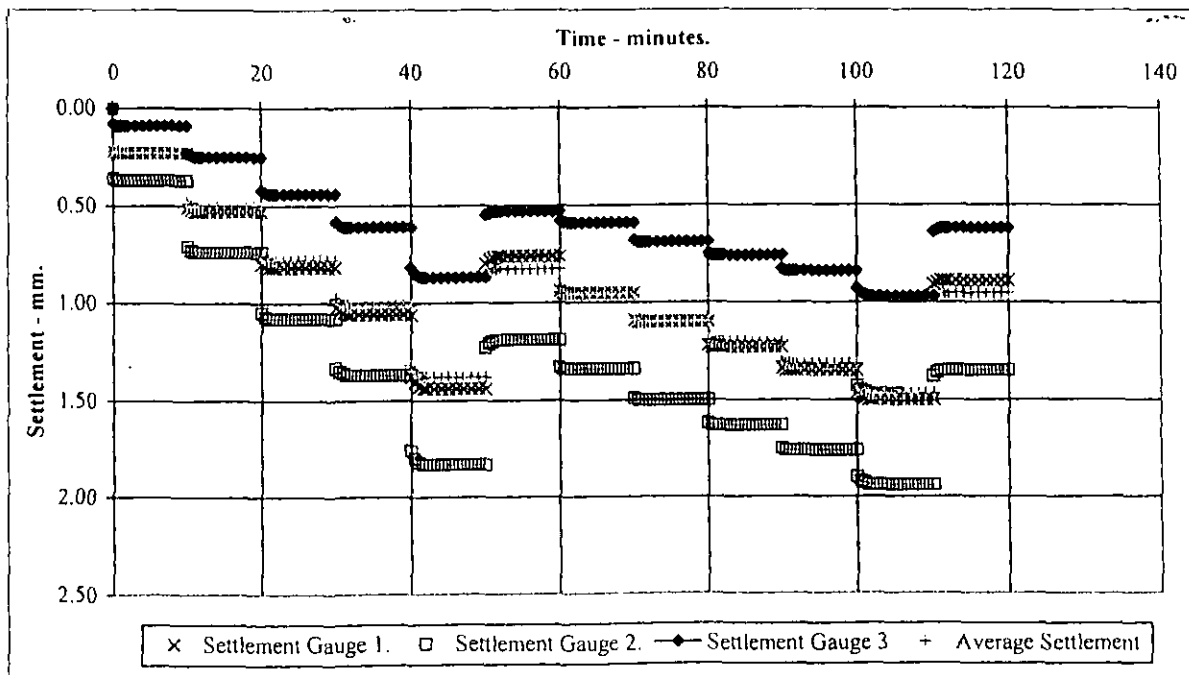
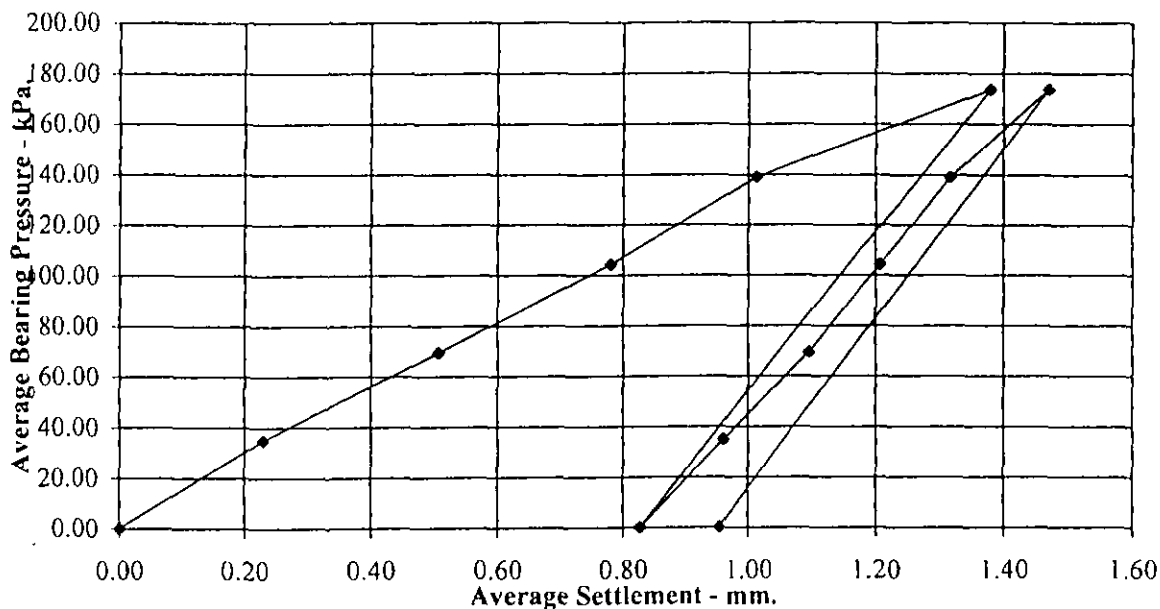
173.76

Maximum Deformation (mm):

1.47

Description:

Crushed Concrete.



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **27**

Engineer: **MJC**

Test Position: **Rd 13 30m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.77	mm
Settlement at end of reload loop:	3.02	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	1.25	mm
Reload settlement < 1.27mm; K =	93	kPa
Correction for plate diameter; K _{mod} =	74	kPa
Subgrade CBR =	21	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67$ kPa), $CBR \approx 10^{(K / 52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 27

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

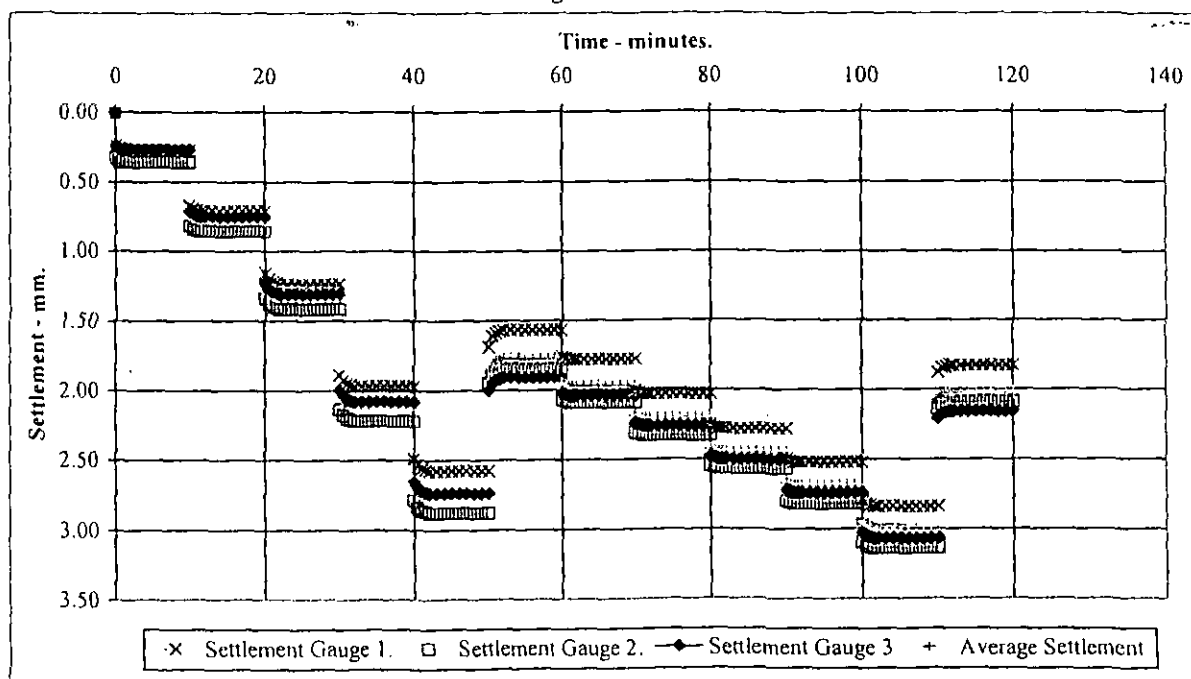
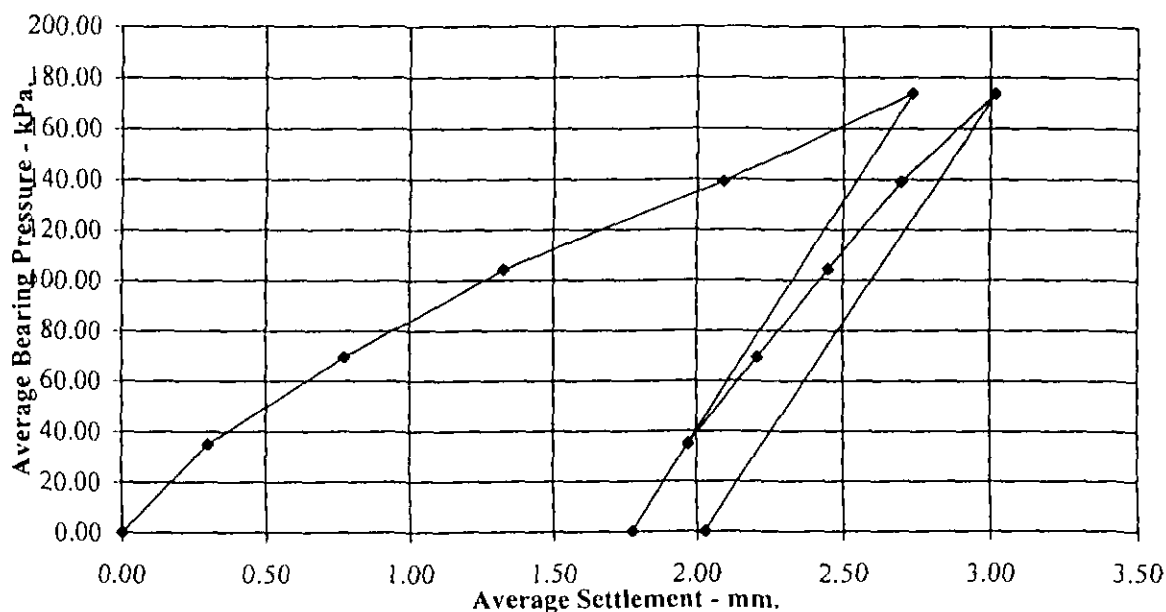
173.76

Maximum Deformation (mm):

3.02

Description:

Crushed Concrete.



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **28**

Engineer: **MJC**

Test Position: **Rd 3 650m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.45	mm
Settlement at end of reload loop:	0.69	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.24	mm
Reload settlement < 1.27mm; K =	489	kPa
Correction for plate diameter; K_{mod} =	392	kPa
Subgrade CBR =	544	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 06-Jun-06

Test Position: 28

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

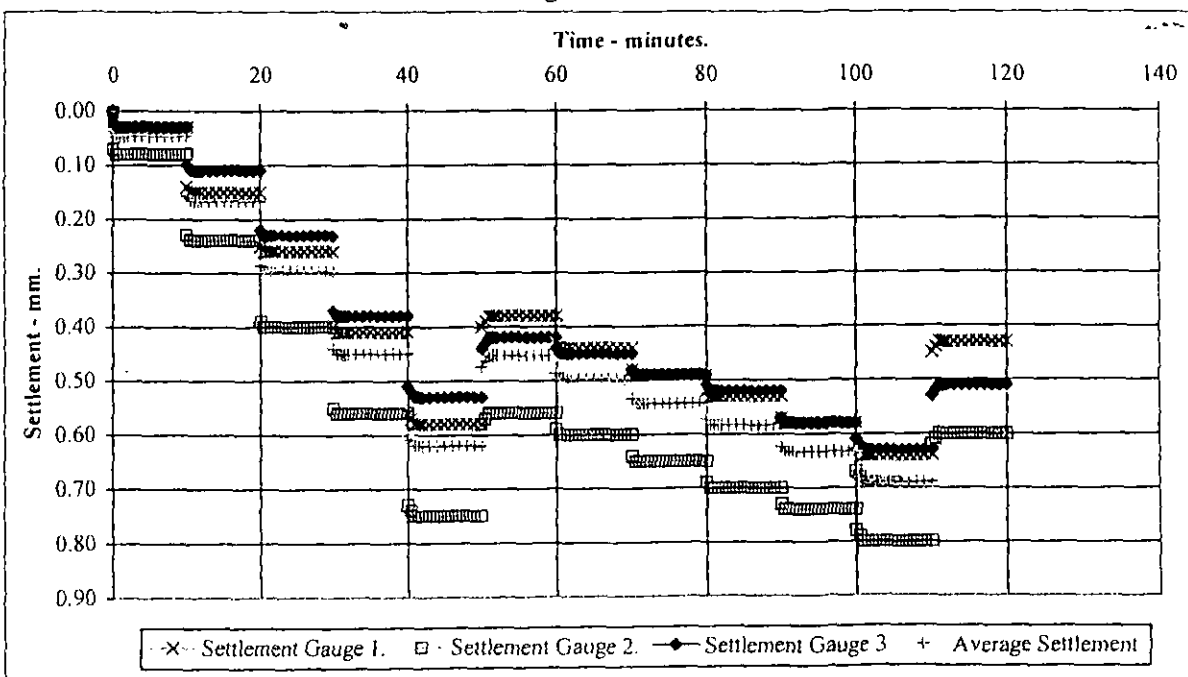
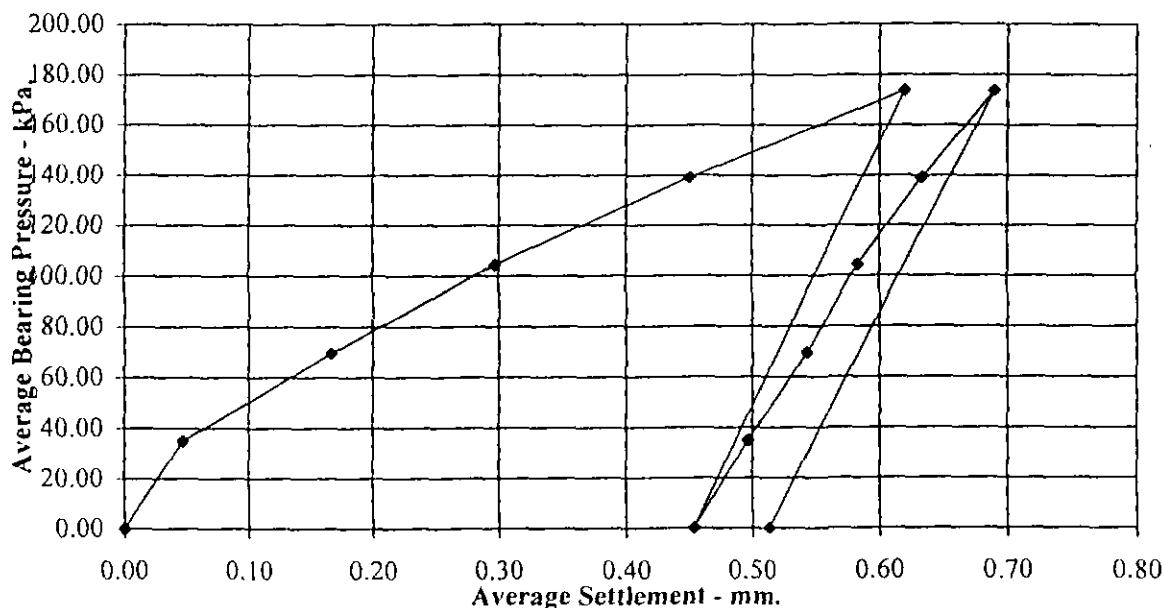
173.76

Maximum Deformation (mm):

0.69

Description:

Crushed Concrete.



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GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: Goldthorpe Colliery

Project No: 9060

Date: 22/06/2006

Test Number: 29

Engineer: MJC

Test Position: Rd 3 600m ch

Fill Type: Crushed Concrete

Depth: Formation Level

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.43	mm
Settlement at end of reload loop:	0.80	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.37	mm
Reload settlement < 1.27mm; K =	314	kPa
Correction for plate diameter; K _{mod} =	251	kPa
Subgrade CBR =	129	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{(K/52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 29

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

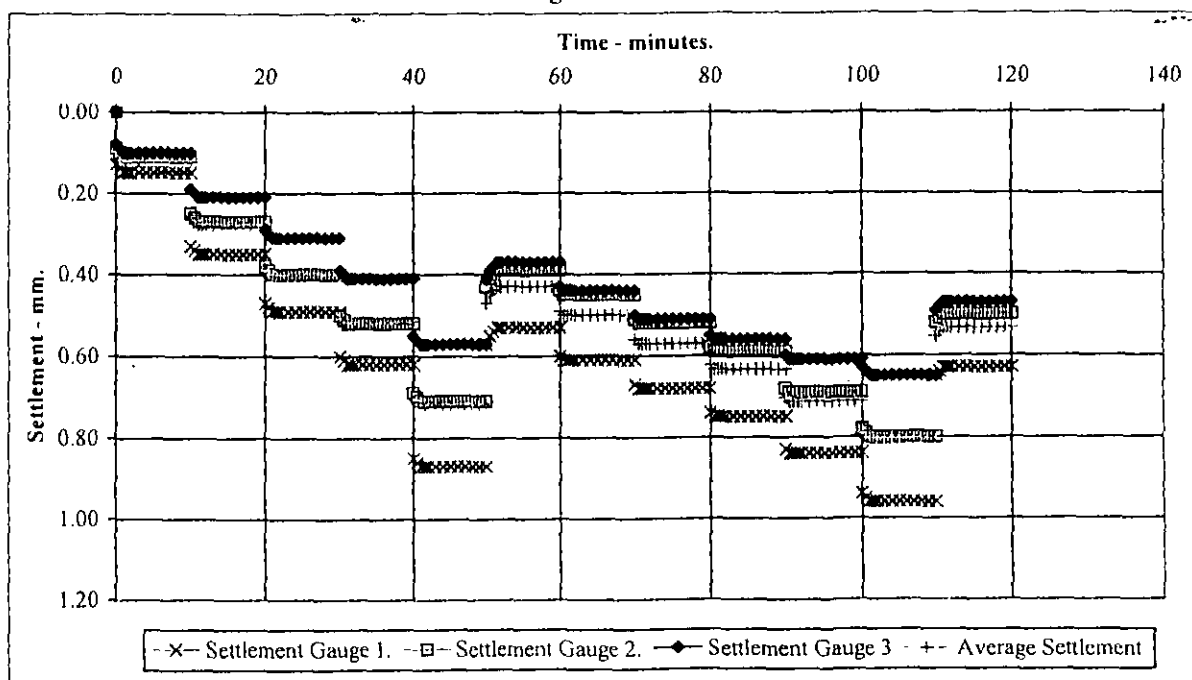
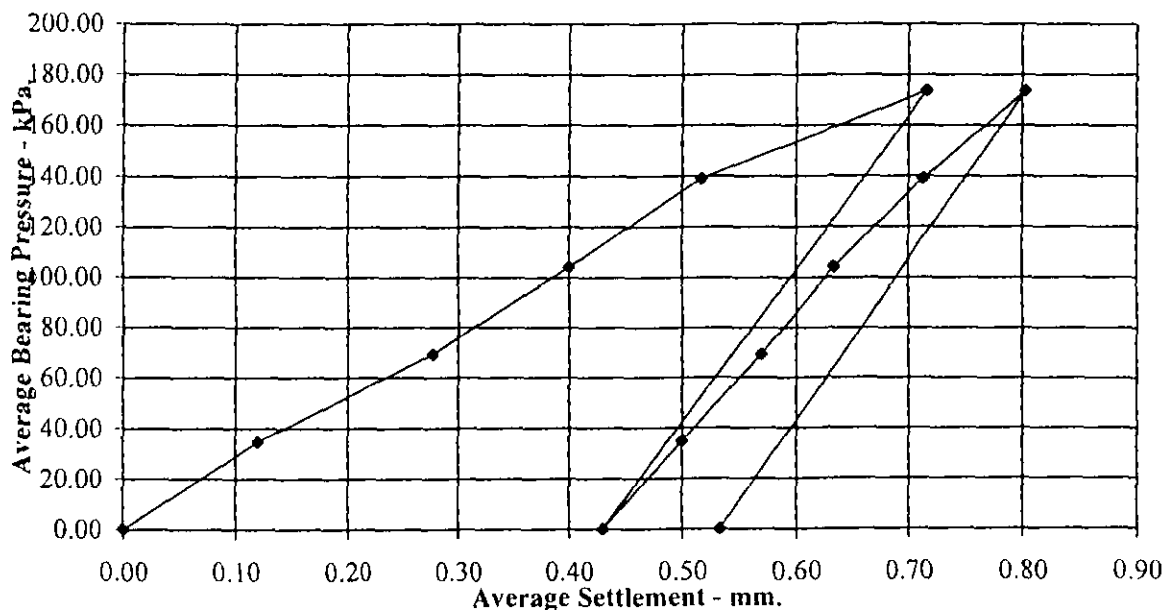
173.76

Maximum Deformation (mm):

0.80

Description:

6F2.



--x-- Settlement Gauge 1. --□-- Settlement Gauge 2. --◆-- Settlement Gauge 3. +- Average Settlement

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GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **30**

Engineer: **MJC**

Test Position: **Rd 3 540m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter: **600** mm
 Settlement at start of reload loop: **0.26** mm
 Settlement at end of reload loop: **0.47** mm
 Maximum test pressure (p): **174** kPa

Calculation

Total reload settlement: **0.21** mm
 Reload settlement < 1.27mm; K = **552** kPa
 Correction for plate diameter; K_{mod} = **442** kPa

 Subgrade CBR = **911** %

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade (K>67kPa), $CBR = 10^{((K \cdot 224)/225)}$

For weak subgrade (K<67kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 30

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

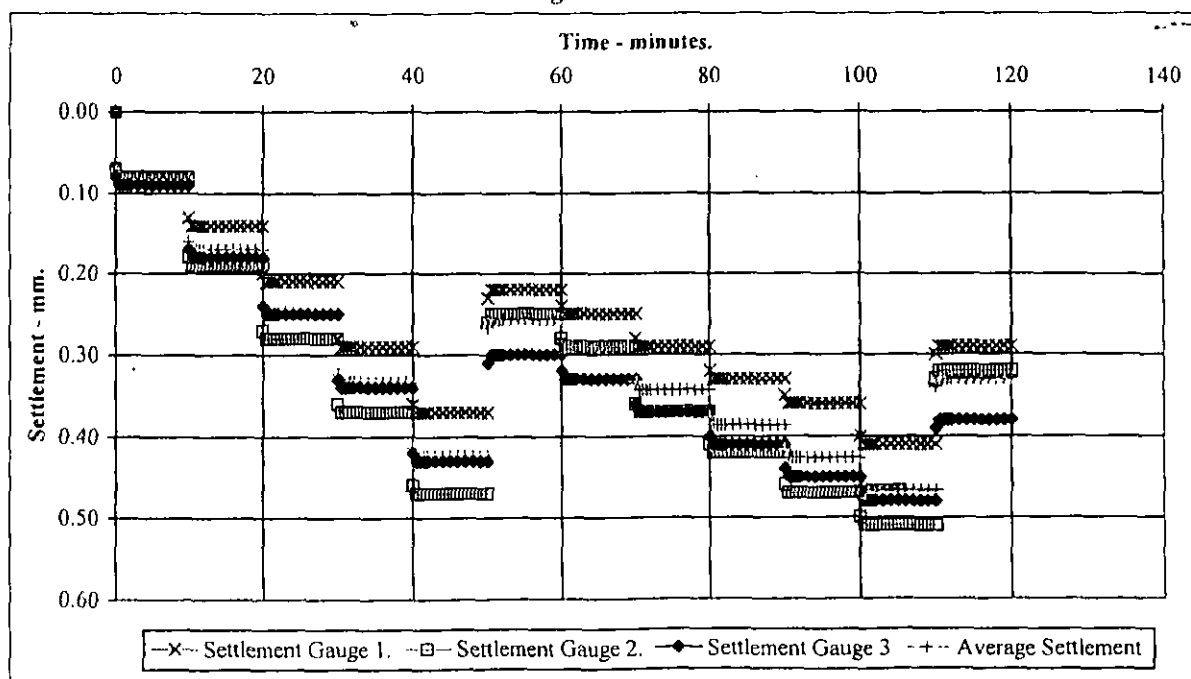
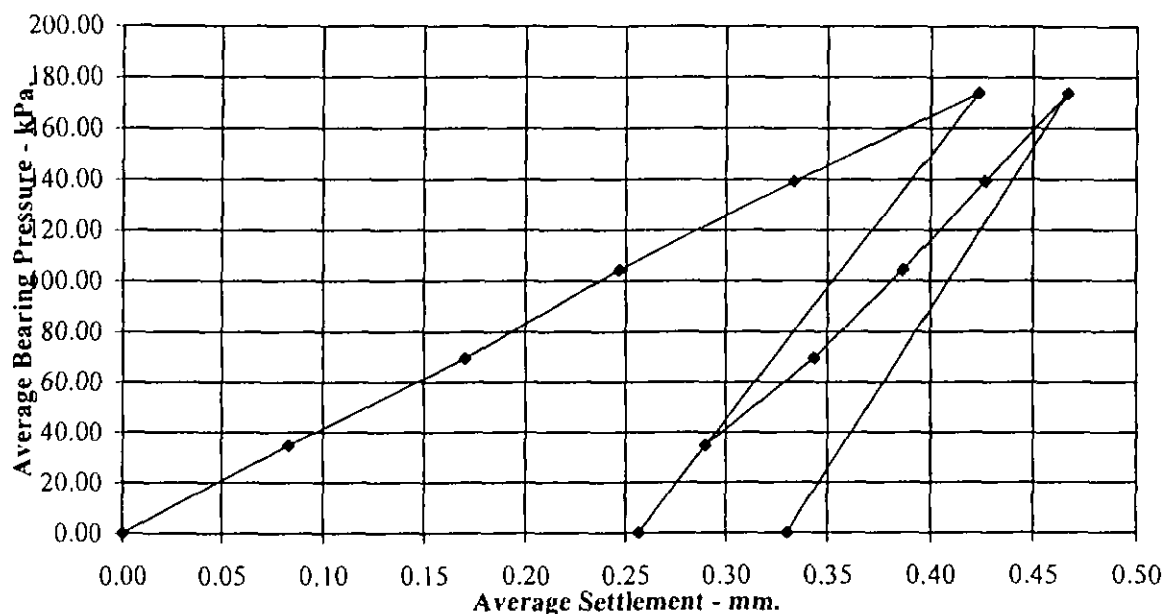
173.76

Maximum Deformation (mm):

0.47

Description:

6F2.



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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **31**

Engineer: **MJC**

Test Position: **Rd 3 500m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.55	mm
Settlement at end of reload loop:	1.03	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.48	mm
Reload settlement < 1.27mm; K =	240	kPa
Correction for plate diameter; K _{mod} =	192	kPa
Subgrade CBR =	71	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/275)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K \times 52.49)/67)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 31

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

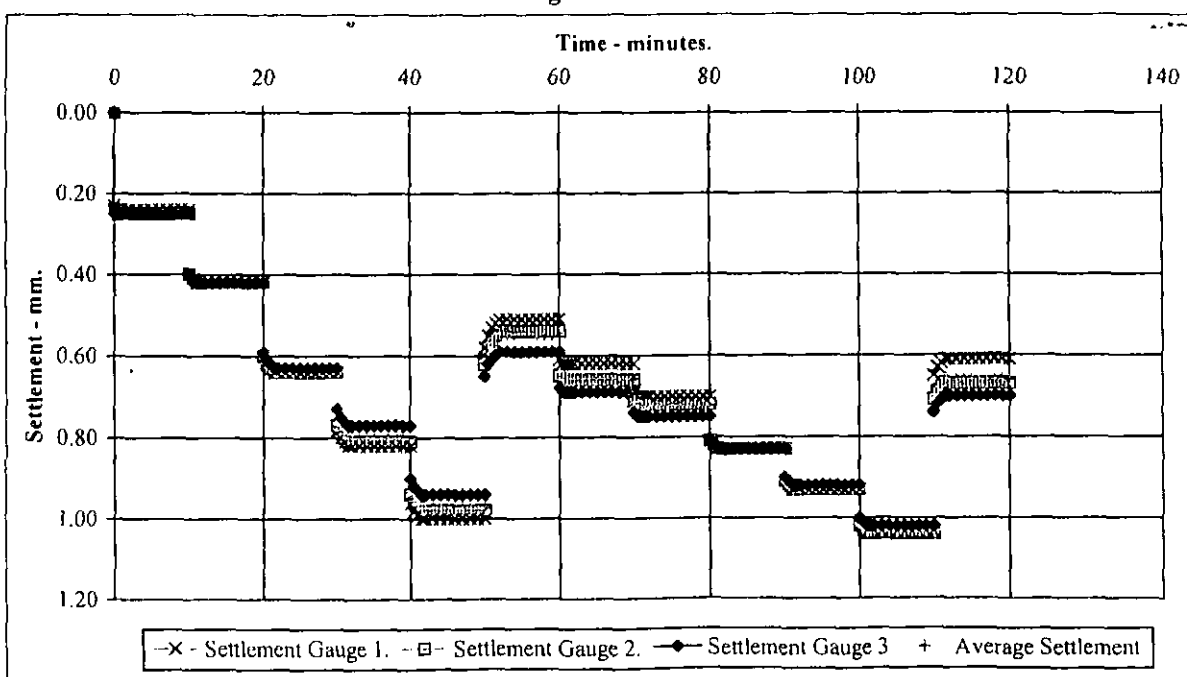
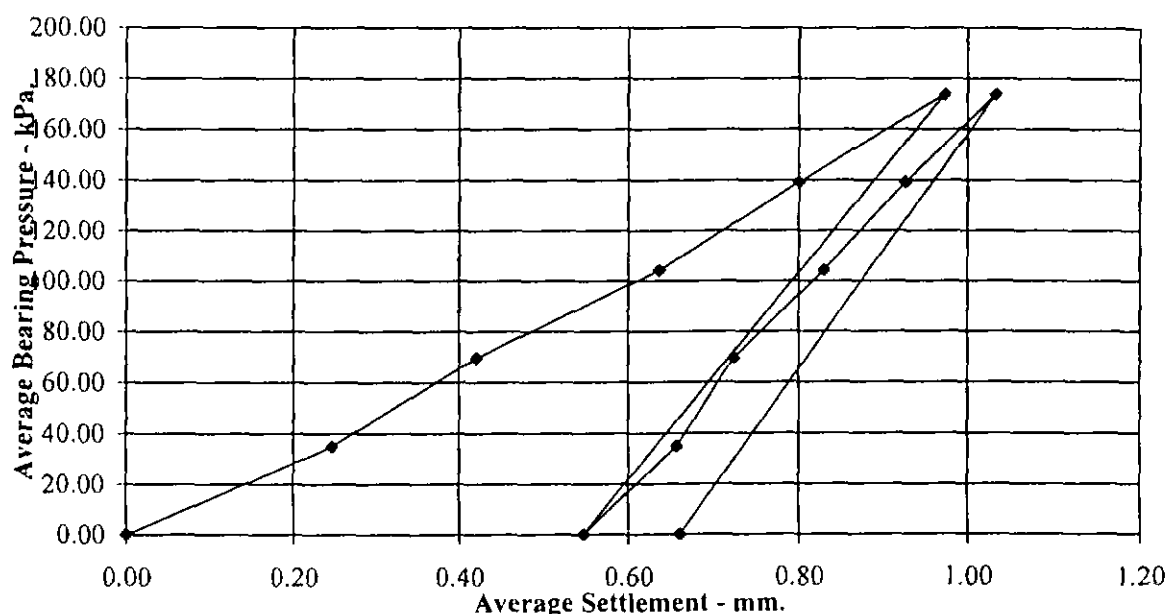
173.76

Maximum Deformation (mm):

1.03

Description:

6F2.



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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **32**

Engineer: **MJC**

Test Position: **Rd 3 460m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.79	mm
Settlement at end of reload loop:	1.31	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.52	mm
Reload settlement < 1.27mm; K =	223	kPa
Correction for plate diameter; K _{mod} =	178	kPa
Subgrade CBR =	61	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \cdot 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \cdot s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \cdot d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \cdot 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K \cdot 52)/49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 32

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

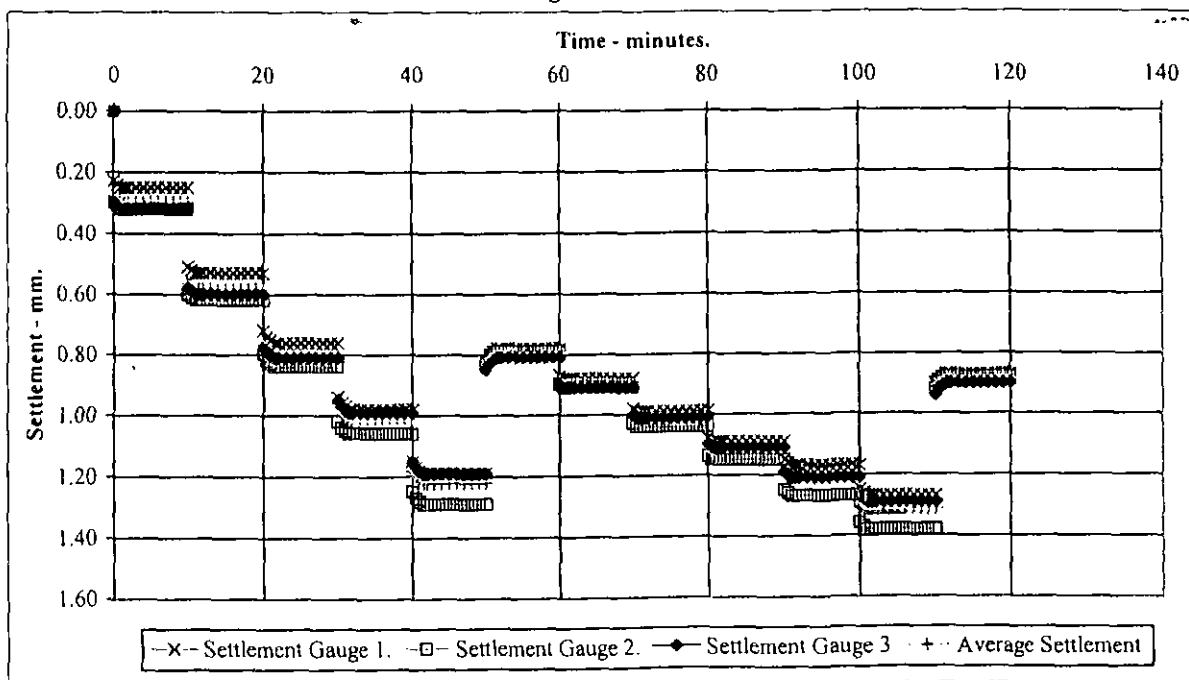
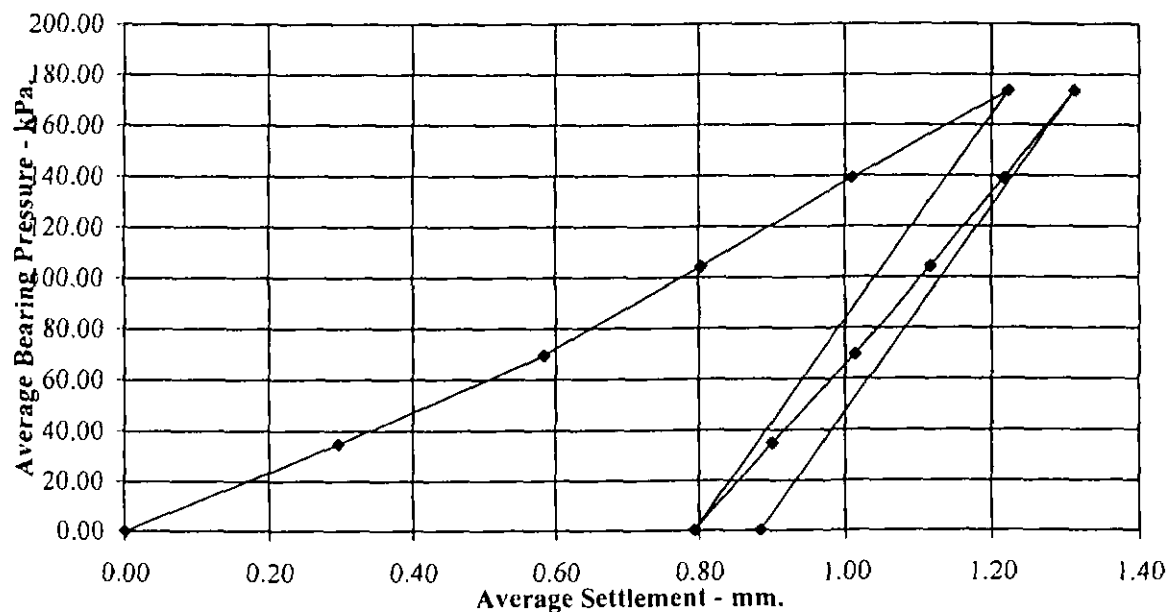
173.76

Maximum Deformation (mm):

1.31

Description:

6F2.



--x-- Settlement Gauge 1. --□-- Settlement Gauge 2. --♦-- Settlement Gauge 3. --+-- Average Settlement

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GOLDTHORPE COLLIERY.						Client Ref.

Calculation of CBR value from Plate Bearing Test results

ENCIA
CRUSHED CONCRETE

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **33**

Engineer: **MJC**

Test Position: **Rd 3 410m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.53	mm
Settlement at end of reload loop:	0.91	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.38	mm
Reload settlement < 1.27mm; K =	308	kPa
Correction for plate diameter; K_{mod} =	246	kPa
Subgrade CBR =	123	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{(K \times 22.4)/225}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K/52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 33

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

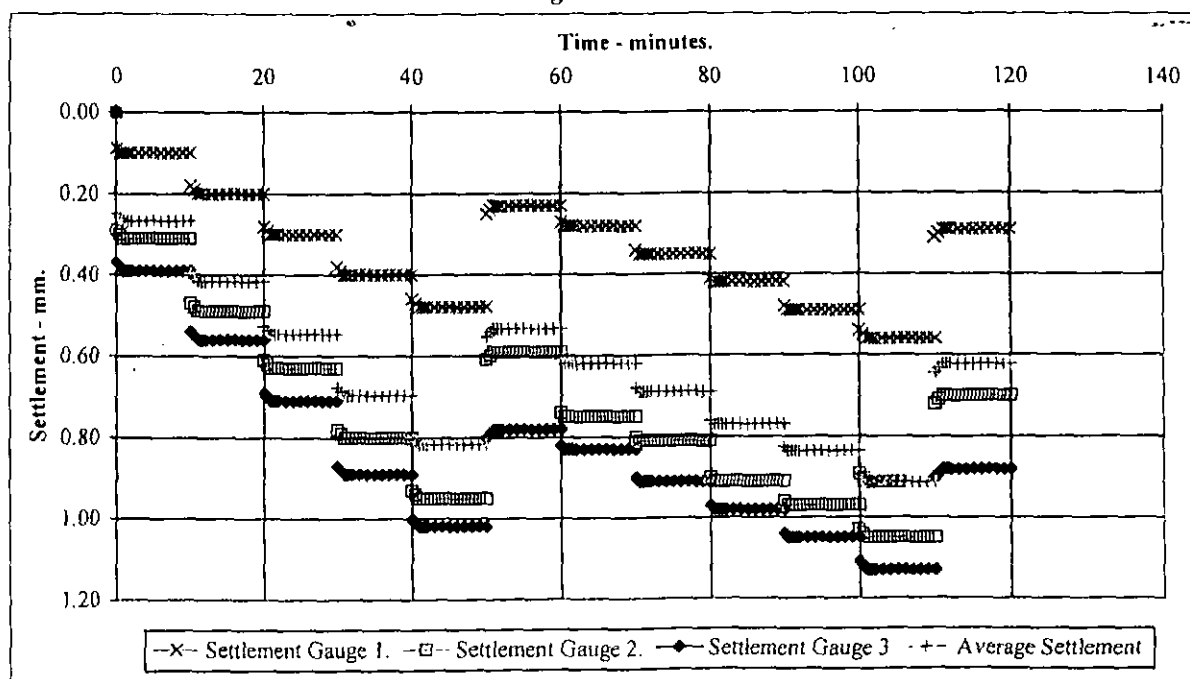
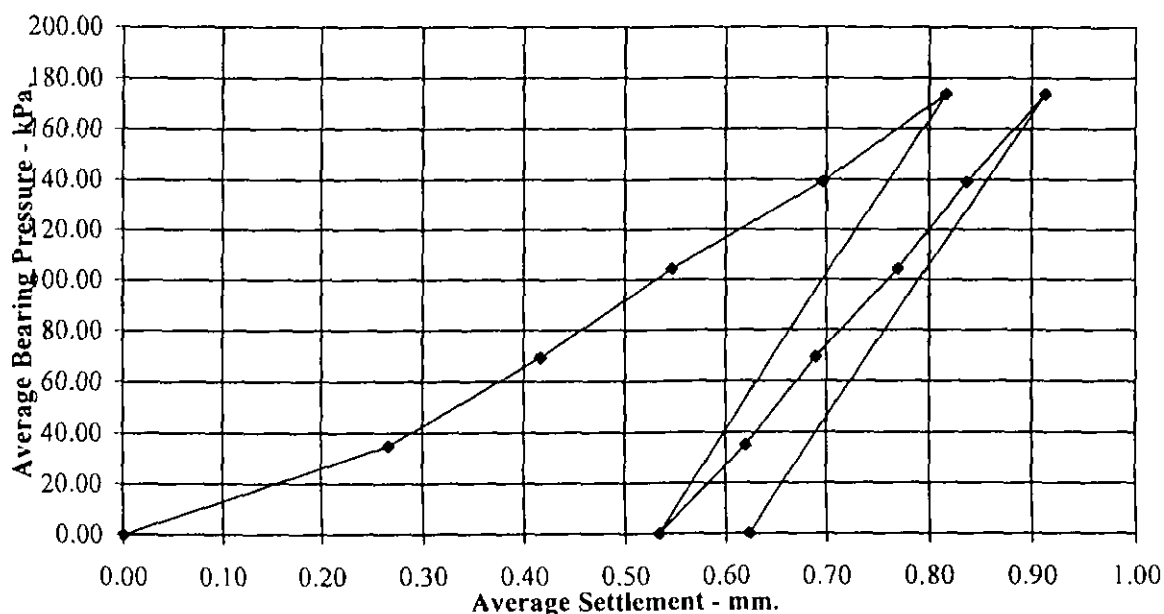
173.76

Maximum Deformation (mm):

0.91

Description:

6F2.



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20/6/06

PSL06/1106

GOLDTHORPE COLLIERY.

Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **34**

Engineer: **MJC**

Test Position: **Rd 3 385m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.53	mm
Settlement at end of reload loop:	1.18	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.65	mm
Reload settlement < 1.27mm; K =	178	kPa
Correction for plate diameter; K_{mod} =	142	kPa
Subgrade CBR =	42	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 34

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

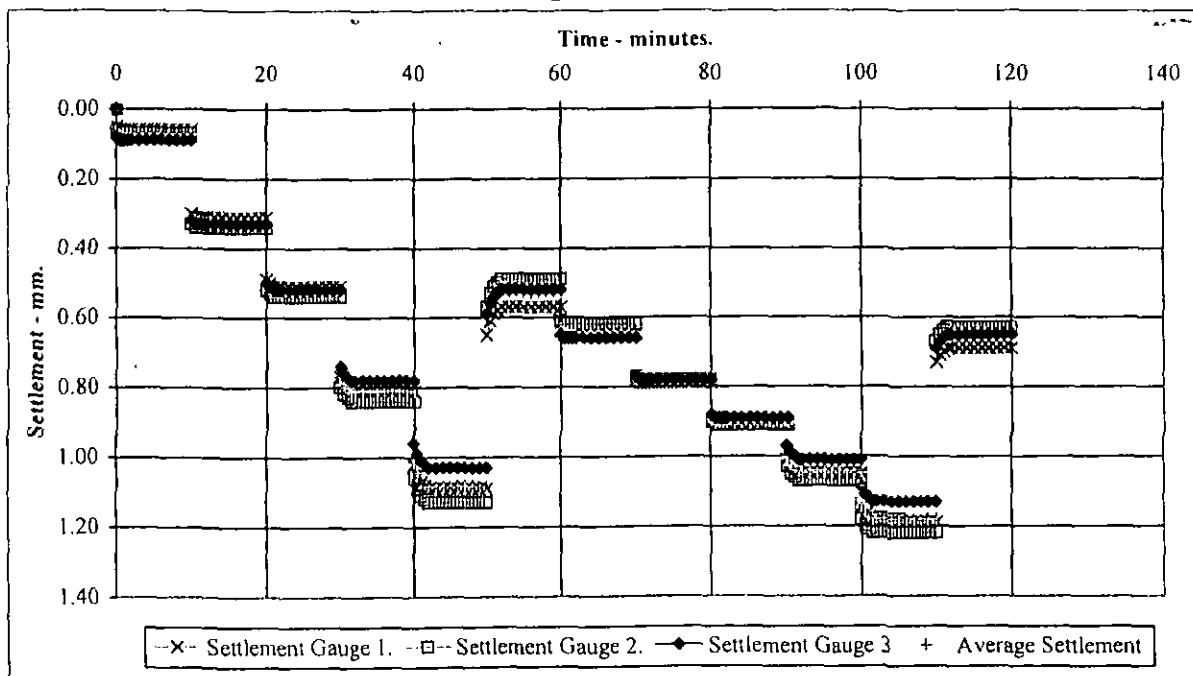
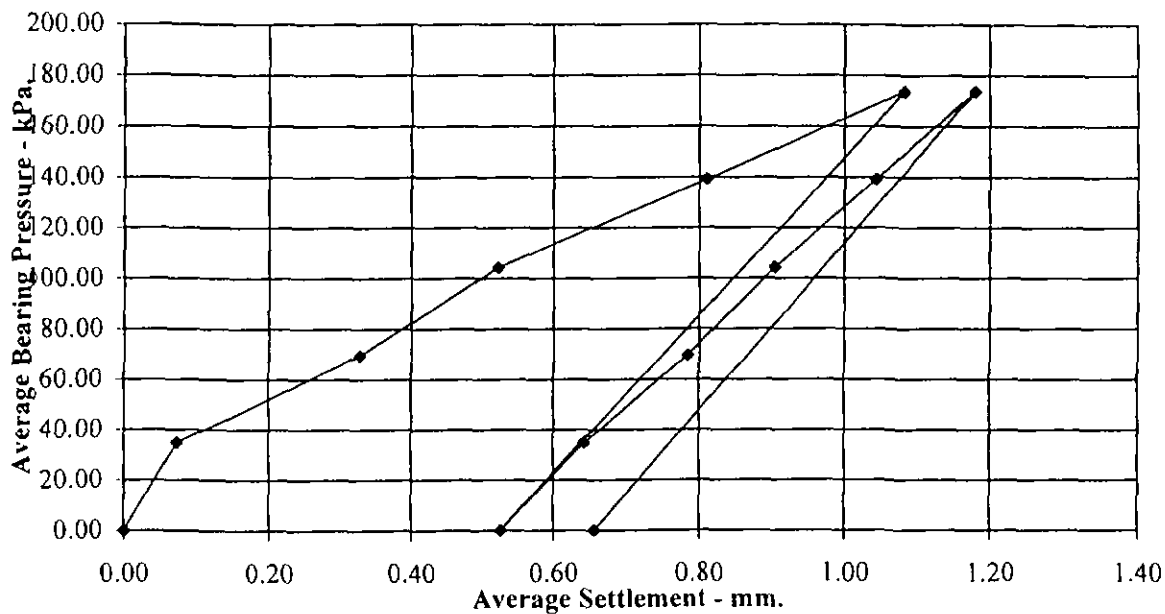
173.76

Maximum Deformation (mm):

1.18

Description:

6F2.



--X-- Settlement Gauge 1. --□-- Settlement Gauge 2. --◆-- Settlement Gauge 3 + Average Settlement

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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **35**

Engineer: **MJC**

Test Position: **Rd 7 20m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.49	mm
Settlement at end of reload loop:	2.84	mm
Pressure (p) for reload settlement of 1.27mm:	160	kPa

Calculation

Total reload settlement:	1.35	mm
Reload settlement > 1.27mm; K =	84	kPa
Correction for plate diameter; K_{mod} =	67	kPa
Subgrade CBR =	19	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 16-Jun-06

Test Position: 35

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

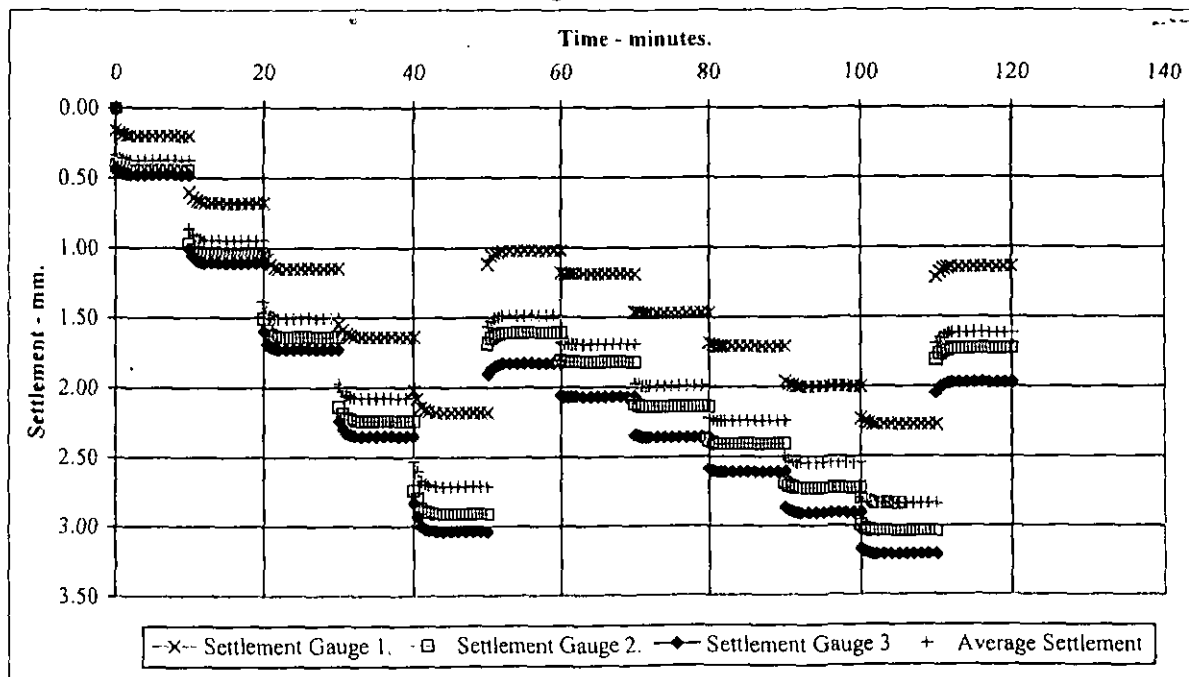
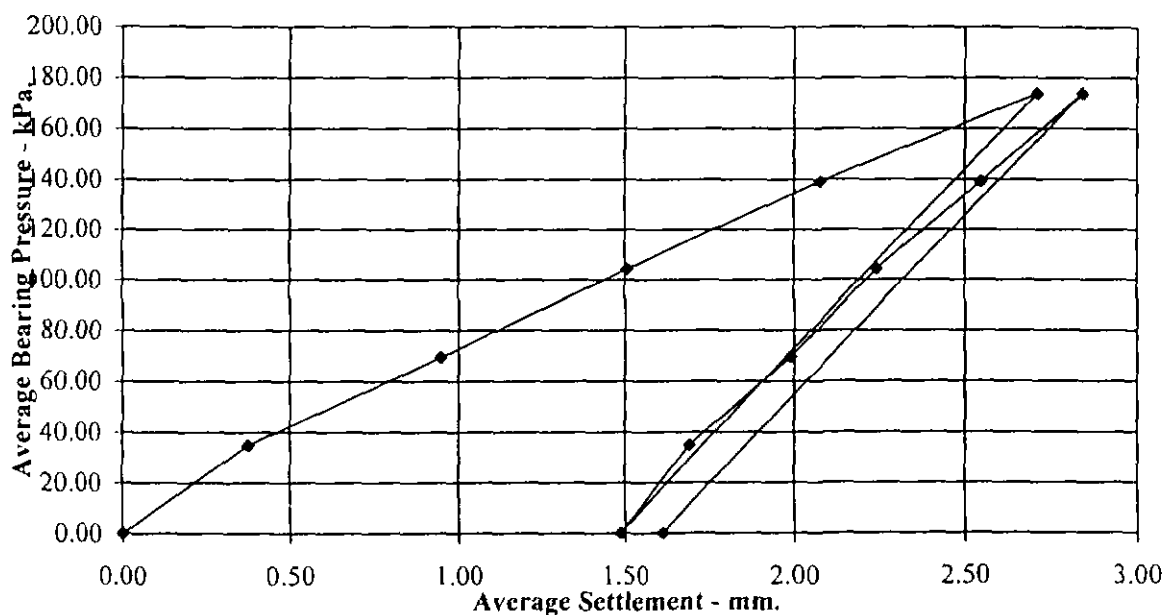
173.76

Maximum Deformation (mm):

2.84

Description:

6F2.



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **36**

Engineer: **MJC**

Test Position: **Rd 7 50m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.20	mm
Settlement at end of reload loop:	1.96	mm
Maximum test pressure (p):	176	kPa

Calculation

Total reload settlement:	0.76	mm
Reload settlement < 1.27mm; K =	154	kPa
Correction for plate diameter; K_{mod} =	124	kPa
Subgrade CBR =	35	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 36

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

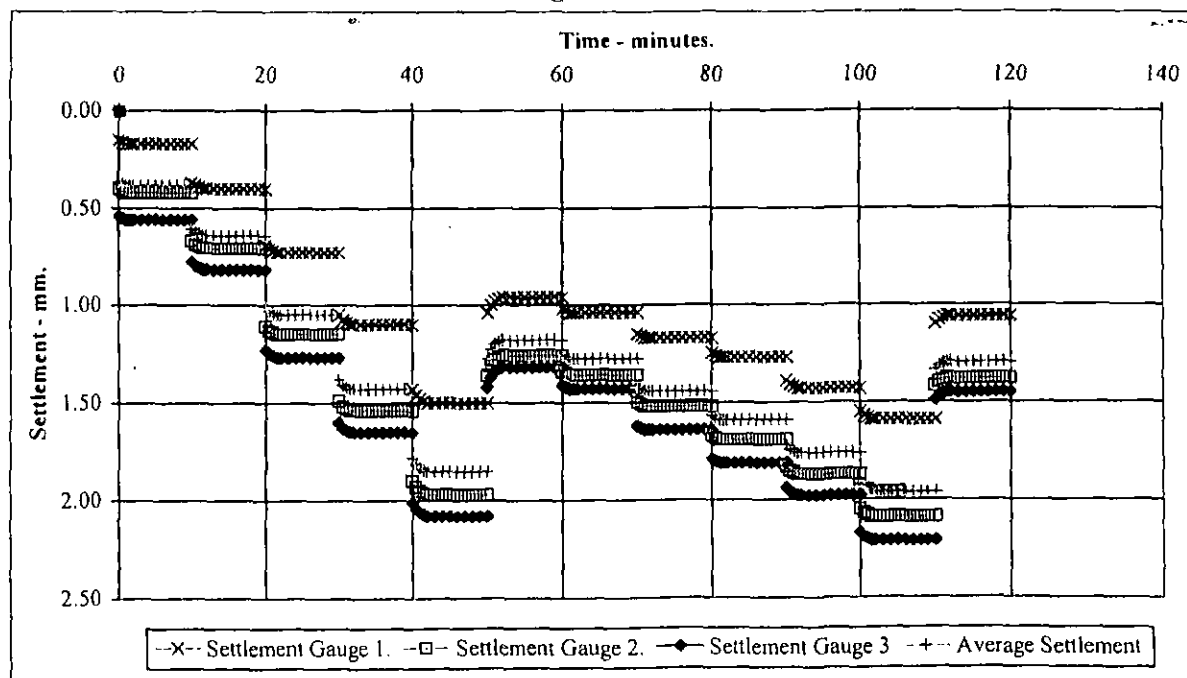
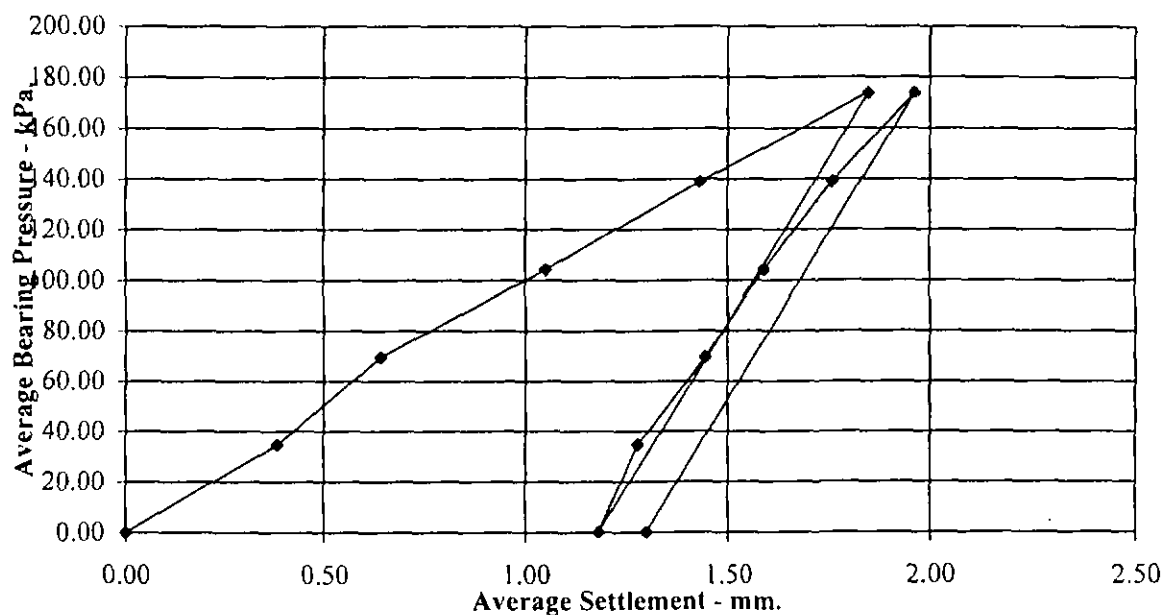
173.76

Maximum Deformation (mm):

1.96

Description:

6F2



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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **37**

Engineer: **MJC**

Test Position: **Rd 7 85m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.75	mm
Settlement at end of reload loop:	1.22	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.47	mm
Reload settlement < 1.27mm; K =	247	kPa
Correction for plate diameter; K_{mod} =	197	kPa
Subgrade CBR =	75	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 37

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

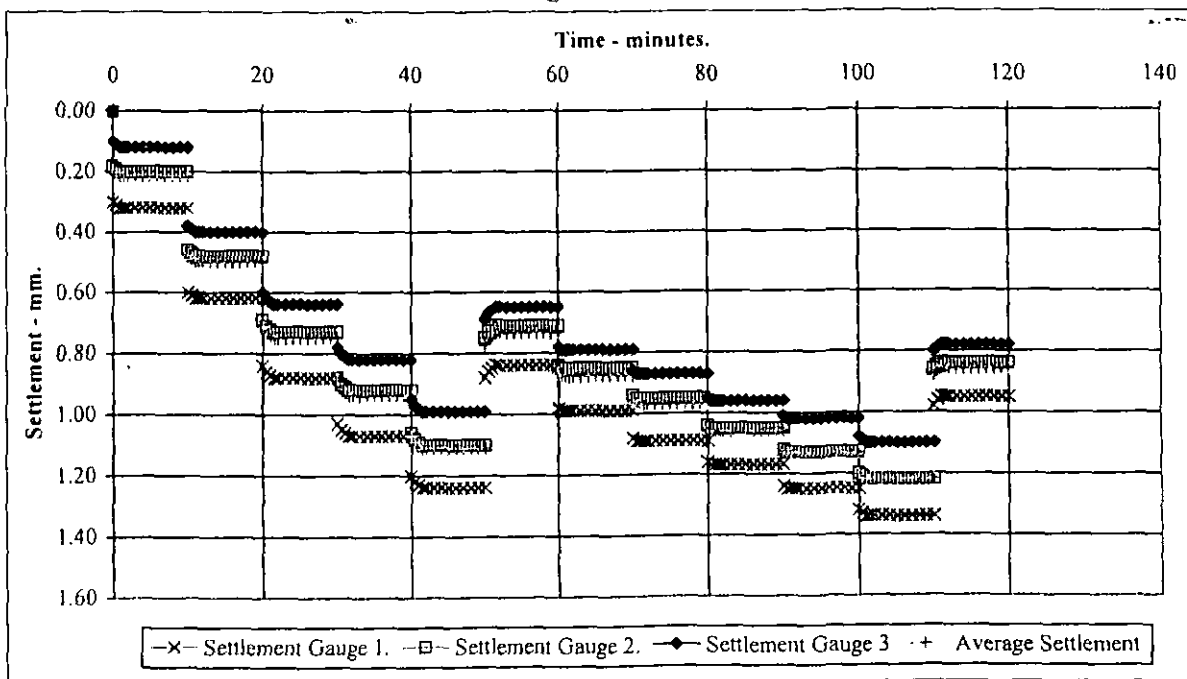
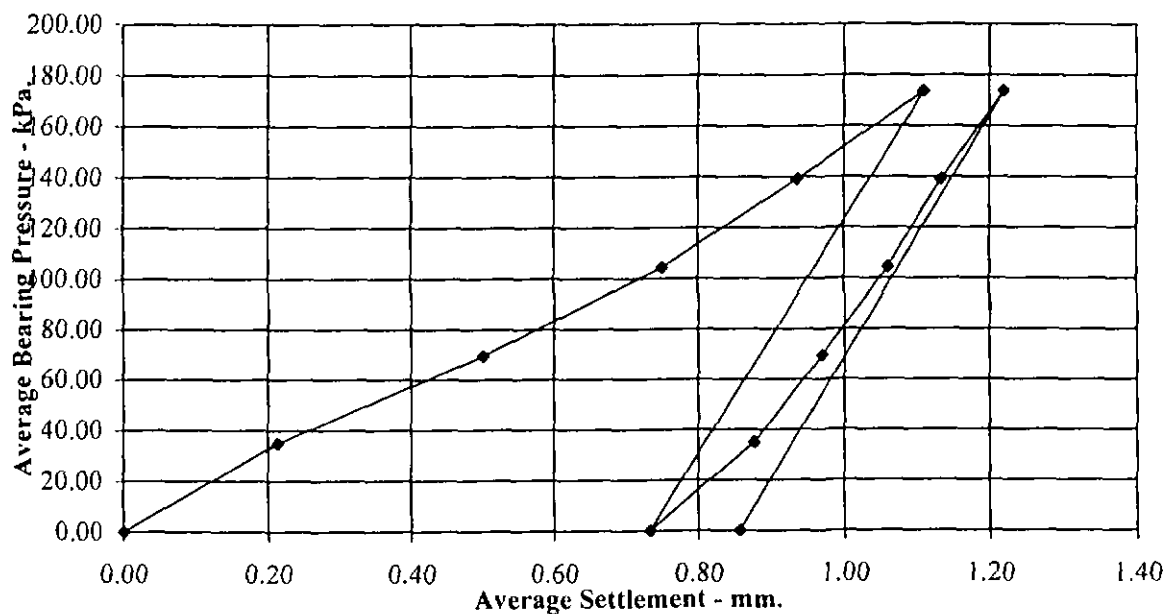
173.76

Maximum Deformation (mm):

1.22

Description:

6F2



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GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results

ENCIA
RESURFACING MATERIALS

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **38**

Engineer: **MJC**

Test Position: **Rd 8 20m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	1.70	mm
Settlement at end of reload loop:	3.19	mm
Pressure (p) for reload settlement of 1.27mm:	115	kPa

Calculation

Total reload settlement:	1.49	mm
Reload settlement > 1.27mm; K =	60	kPa
Correction for plate diameter; K _{mod} =	48	kPa
Subgrade CBR =	8	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224) / 225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{(K / 52.48)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 38

Depth (m): Formation Level

Plate Area (m2): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

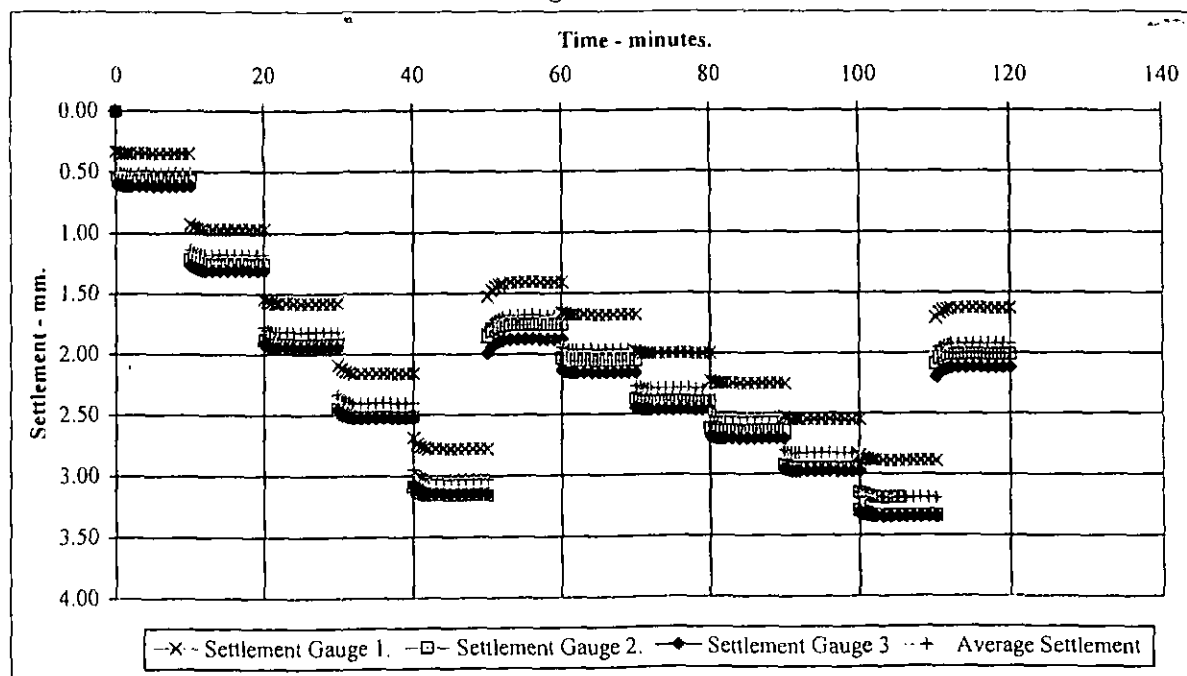
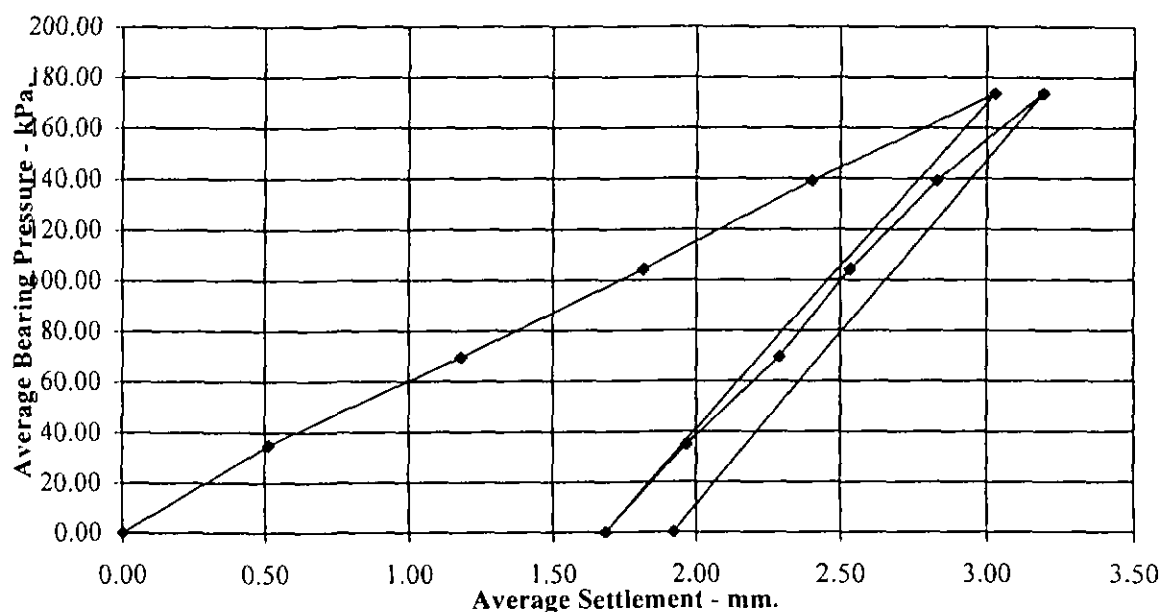
173.76

Maximum Deformation (mm):

3.19

Description:

6F2



-x- Settlement Gauge 1. -□- Settlement Gauge 2. -◆- Settlement Gauge 3. -+ Average Settlement

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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **39**

Engineer: **MJC**

Test Position: **Rd 9 35m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.55	mm
Settlement at end of reload loop:	1.02	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.47	mm
Reload settlement < 1.27mm; K =	247	kPa
Correction for plate diameter; K_{mod} =	197	kPa
Subgrade CBR =	75	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 39

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

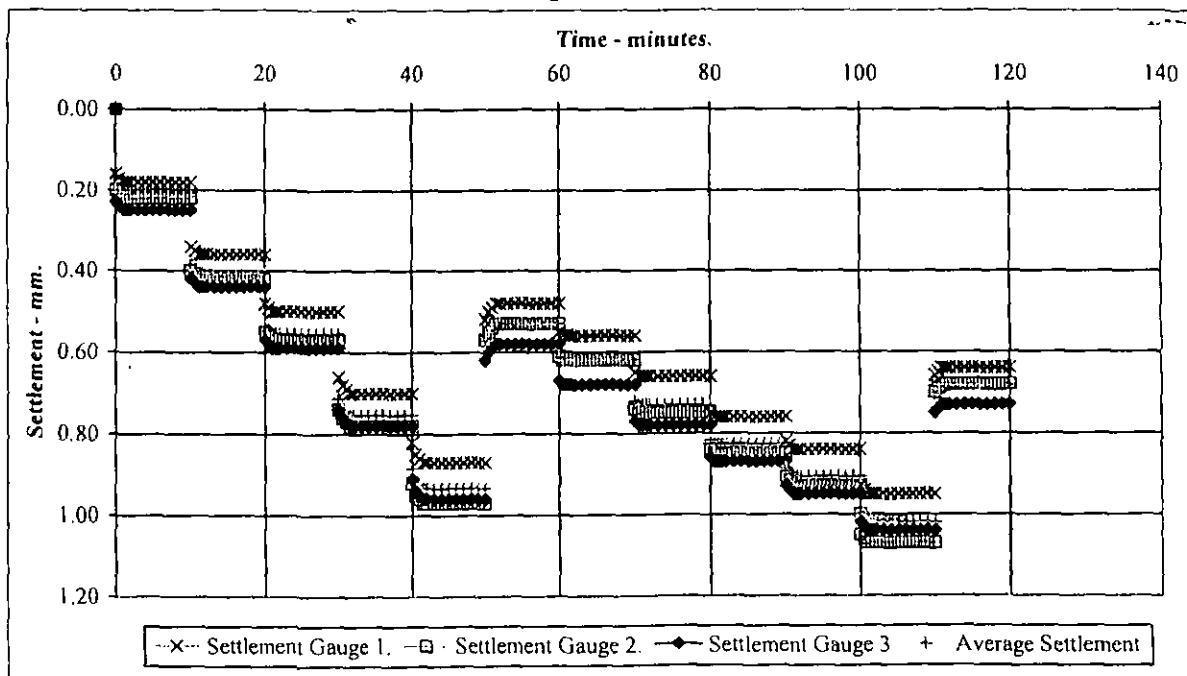
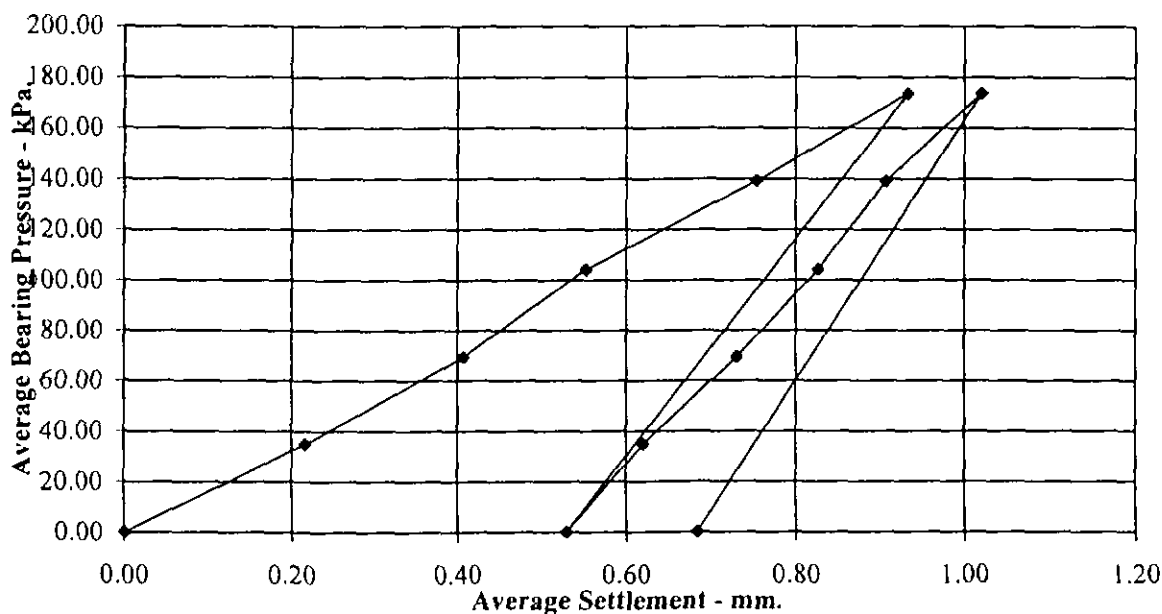
173.76

Maximum Deformation (mm):

1.02

Description:

6F2



--X-- Settlement Gauge 1. --□-- Settlement Gauge 2. --♦-- Settlement Gauge 3. + Average Settlement

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Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **40**

Engineer: **MJC**

Test Position: **Rd 8 60m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.62	mm
Settlement at end of reload loop:	1.07	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.45	mm
Reload settlement < 1.27mm; K =	258	kPa
Correction for plate diameter; K _{mod} =	206	kPa
Subgrade CBR =	82	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 40

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

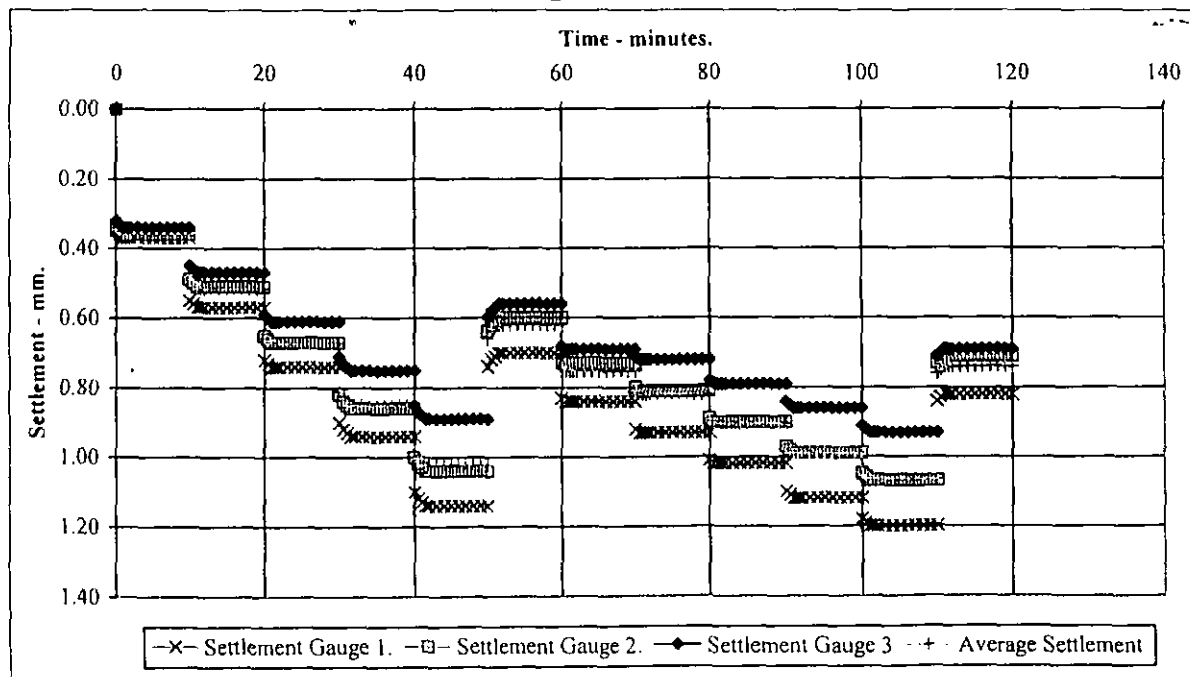
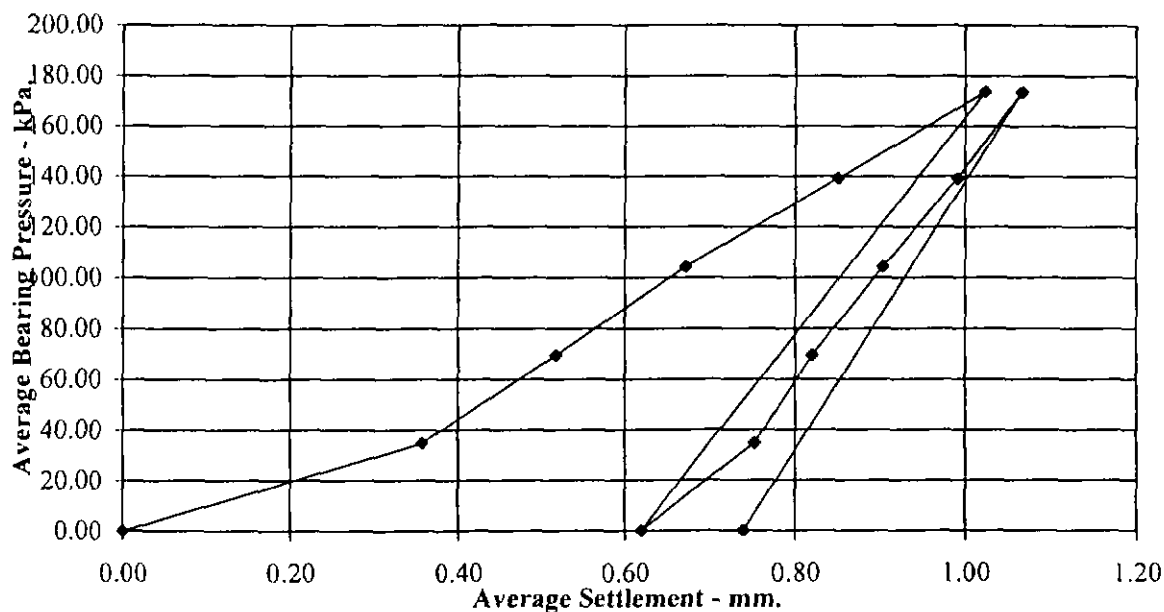
173.76

Maximum Deformation (mm):

1.07

Description:

6F2



-x- Settlement Gauge 1. -□- Settlement Gauge 2. -◆- Settlement Gauge 3. -+- Average Settlement

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GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results

ENCIA
Engineering and Construction Information

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **41**

Engineer: **MJC**

Test Position: **Rd 9 10m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.90	mm
Settlement at end of reload loop:	1.40	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.50	mm
Reload settlement < 1.27mm; K =	232	kPa
Correction for plate diameter; K_{mod} =	186	kPa
Subgrade CBR =	66	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
 For strong subgrade ($K > 67 \text{ kPa}$), $CBR = 10^{((K \times 22.4)/225)}$
 For weak subgrade ($K < 67 \text{ kPa}$), $CBR = 10^{((K/52) \times 40)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 41

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

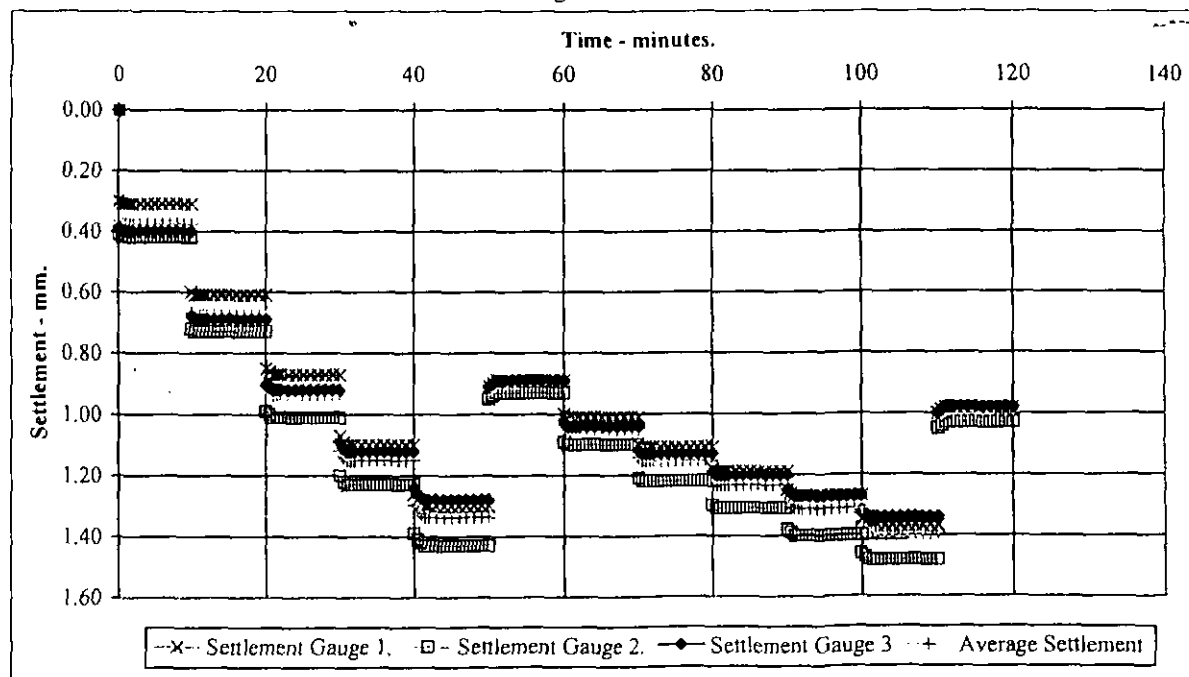
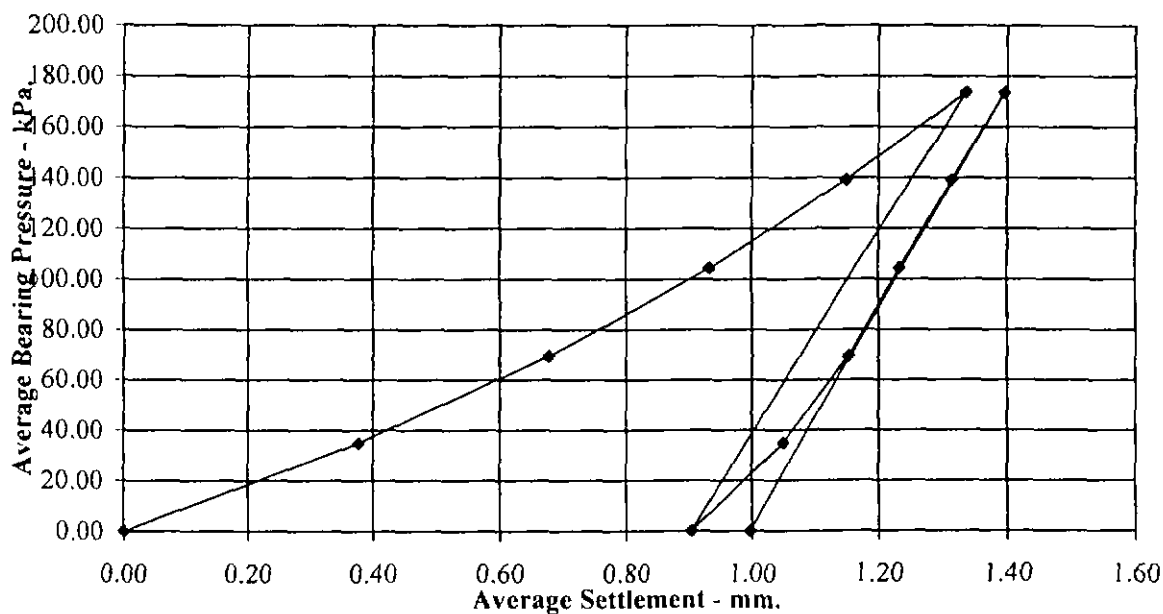
173.76

Maximum Deformation (mm):

1.40

Description:

6F2



Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>[Signature]</i>	20/6/06	<i>[Signature]</i>	20/6/06	<i>[Signature]</i>	20/6/06	PSL06/1110
GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results



Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **22/06/2006**

Test Number: **42**

Engineer: **MJC**

Test Position: **Rd 11 25m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.75	mm
Settlement at end of reload loop:	1.22	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.47	mm
Reload settlement < 1.27mm; K =	247	kPa
Correction for plate diameter; K _{mod} =	197	kPa
Subgrade CBR =	75	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{(K / 52.49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 19-Jun-06

Test Position: 42

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

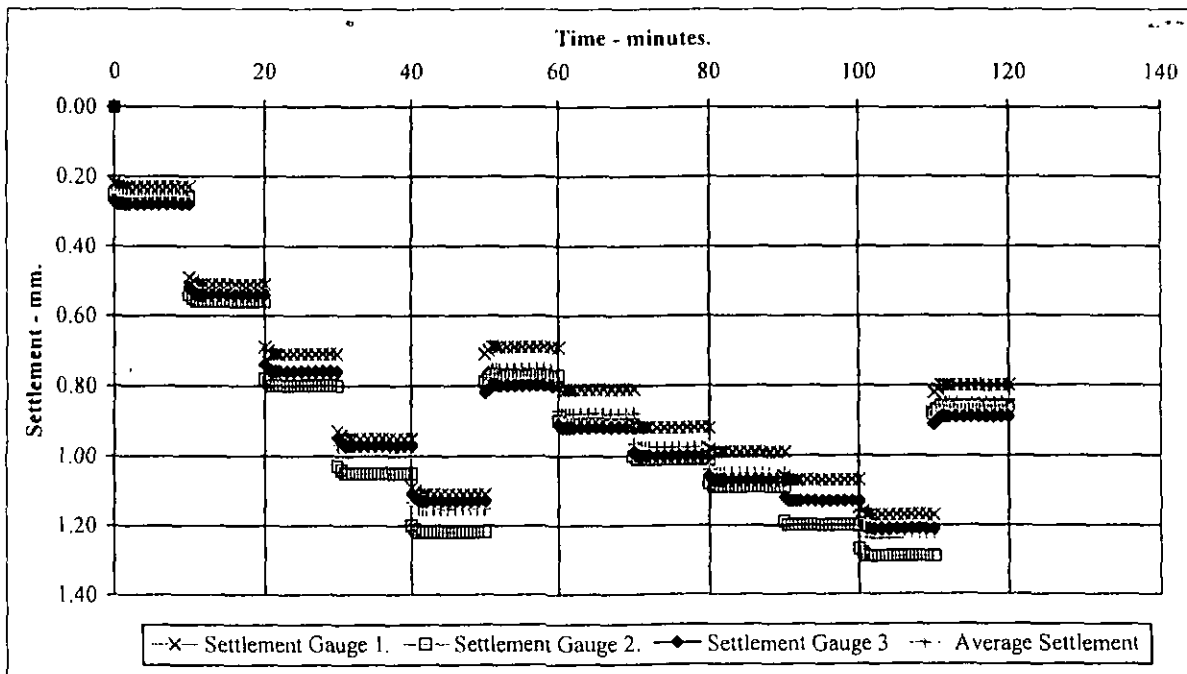
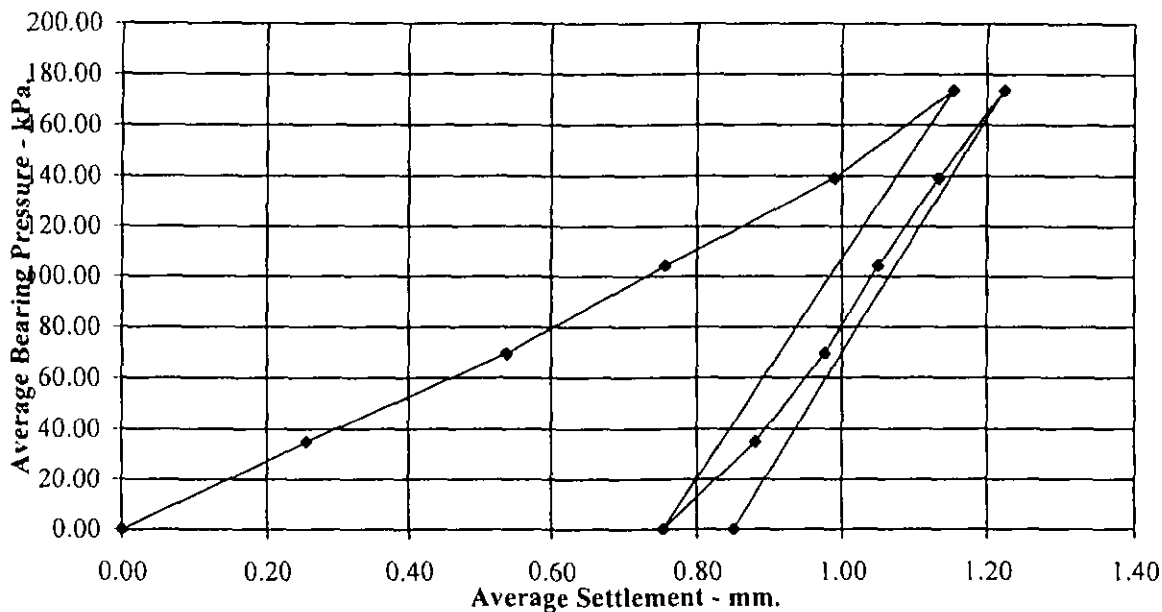
173.76

Maximum Deformation (mm):

1.22

Description:

6F2



--x-- Settlement Gauge 1. --□-- Settlement Gauge 2. --♦-- Settlement Gauge 3. --+-- Average Settlement

Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
<i>[Signature]</i>	20/6/06	<i>[Signature]</i>	20/6/06	<i>[Signature]</i>	20/6/06	PSL06/1110
GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results

ENCIA
Engineering & Construction
 Infrastructure & Construction

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **17/07/2006**

Test Number: **43**

Engineer: **MJC**

Test Position: **Rd 10 55m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.47	mm
Settlement at end of reload loop:	0.76	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.29	mm
Reload settlement < 1.27mm; K =	400	kPa
Correction for plate diameter; K_{mod} =	320	kPa
Subgrade CBR =	262	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p / (1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm

2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max} / (1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop

3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d) / 750$, where d is the plate diameter in mm

4) The subgrade CBR is then calculated as follows:

For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224) / 225)}$

For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K / 52.49))}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 05-Jul-06

Test Position: 43

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

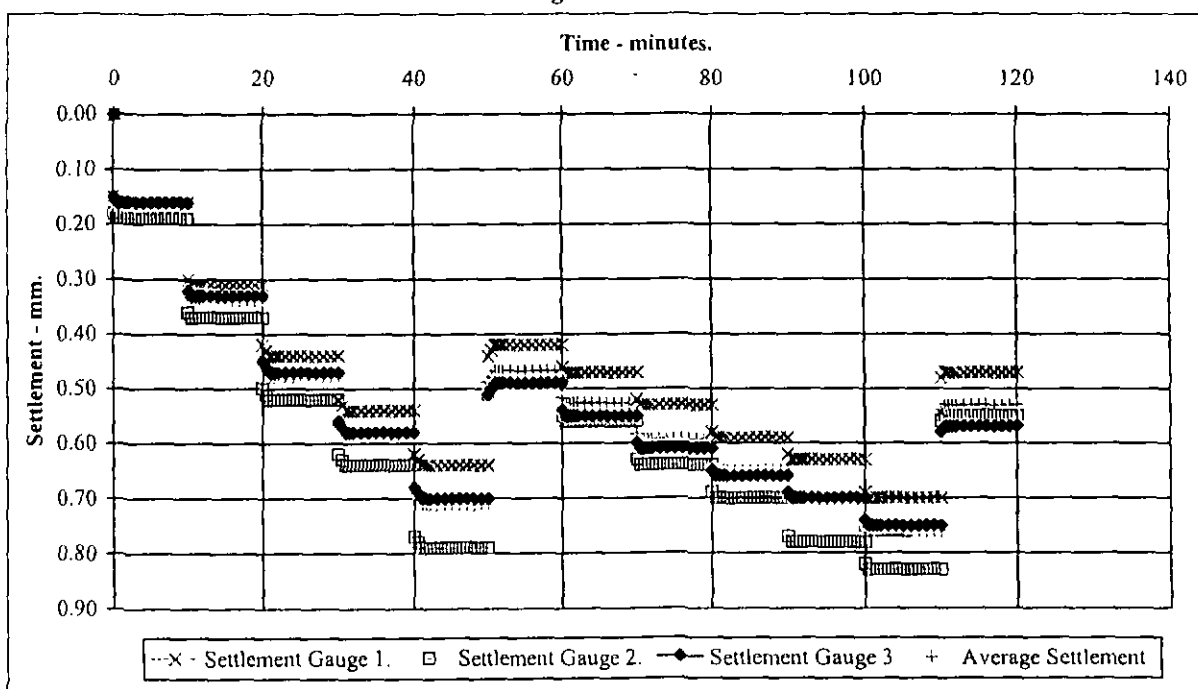
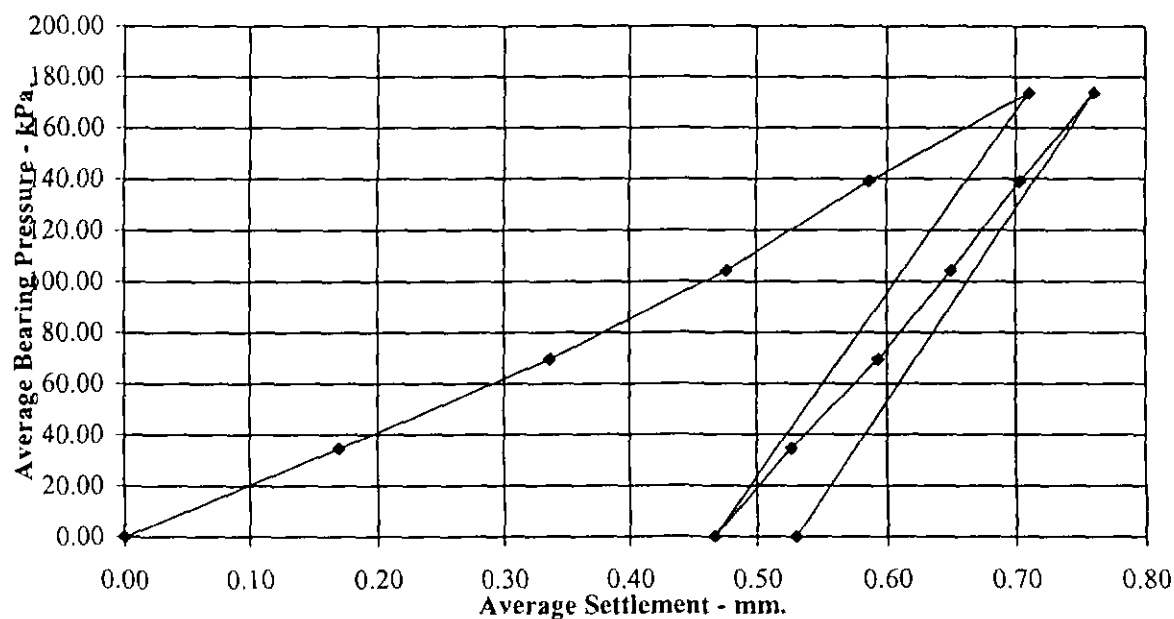
173.76

Maximum Deformation (mm):

0.76

Description:

6F2



Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
						PSL06/1230
GOLDTHORPE COLLIERY						Client Ref.

Calculation of CBR value from Plate Bearing Test results

ENCIA
TESTING LIMITED

Project Data

Site: **Goldthorpe Colliery**

Project No: **9060**

Date: **17/07/2006**

Test Number: **44**

Engineer: **MJC**

Test Position: **Rd 10 15m ch**

Fill Type: **Crushed Concrete**

Depth: **Formation Level**

Test Data

Plate diameter:	600	mm
Settlement at start of reload loop:	0.44	mm
Settlement at end of reload loop:	0.80	mm
Maximum test pressure (p):	174	kPa

Calculation

Total reload settlement:	0.36	mm
Reload settlement < 1.27mm; K =	322	kPa
Correction for plate diameter; K _{mod} =	258	kPa
Subgrade CBR =	138	%

NB: Project / test data to be entered in shaded cells

Notes on Calculation Method

Method based upon work conducted by the TRL and used by the West Yorkshire Highways Laboratory

- 1) If greater than 1.27mm settlement during reload loop of test, Modulus of Subgrade Reaction (K, in kPa) calculated as $K = p/(1.5 \times 1.27)$, where p is the pressure (in kPa) corresponding to reload settlement of 1.27mm
- 2) For strong subgrades, where the Modulus of Subgrade Reaction is less than 67 kPa, $K = p_{max}/(1.5 \times s_{max})$, where p_{max} is the maximum applied test pressure and s_{max} is the maximum settlement during the reload loop
- 3) The method assumes a plate diameter of 750mm is used. For different plate diameters the Modulus of Subgrade Reaction is modified using the expression $K_{mod} = (K \times d)/750$, where d is the plate diameter in mm
- 4) The subgrade CBR is then calculated as follows:
For strong subgrade ($K > 67$ kPa), $CBR = 10^{((K \times 224)/225)}$
For weak subgrade ($K < 67$ kPa), $CBR = 10^{((K/52) \times 49)}$

VERTICAL DEFORMATION TESTS.

BS 1377 : Part 9 : 1990.

Date of Test: 05-Jul-06

Test Position: 44

Depth (m): Formation Level

Plate Area (m²): 0.2827

Type of Kentledge: Tracked

Maximum Applied Pressure (kPa):

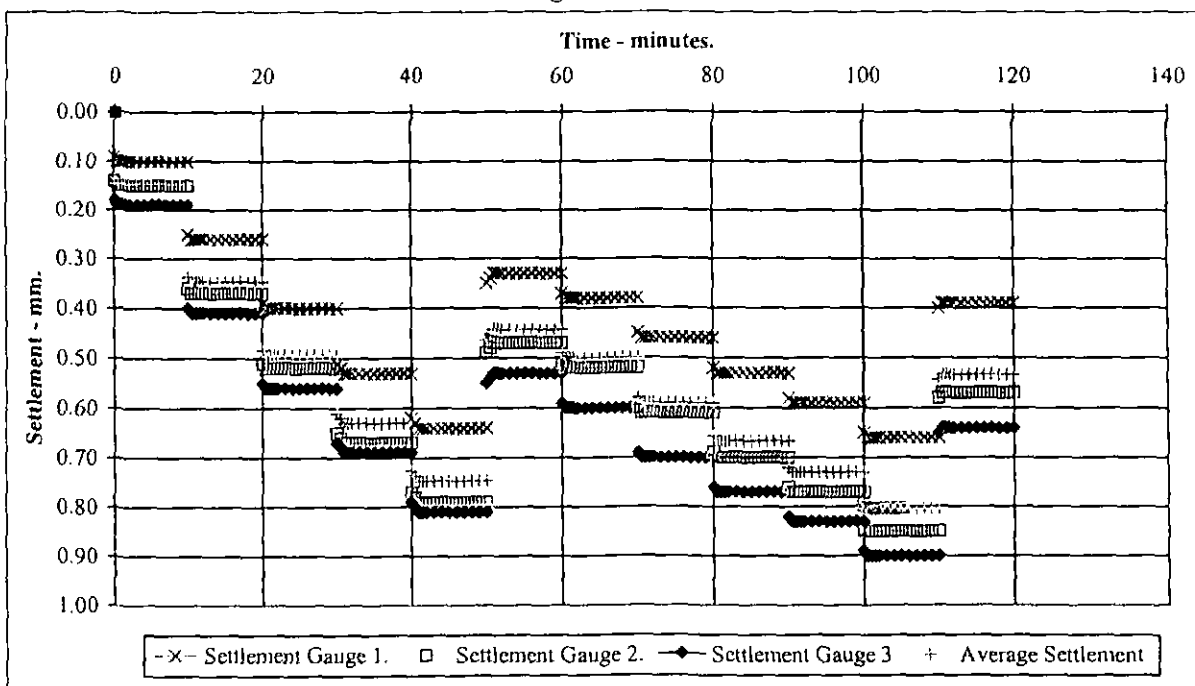
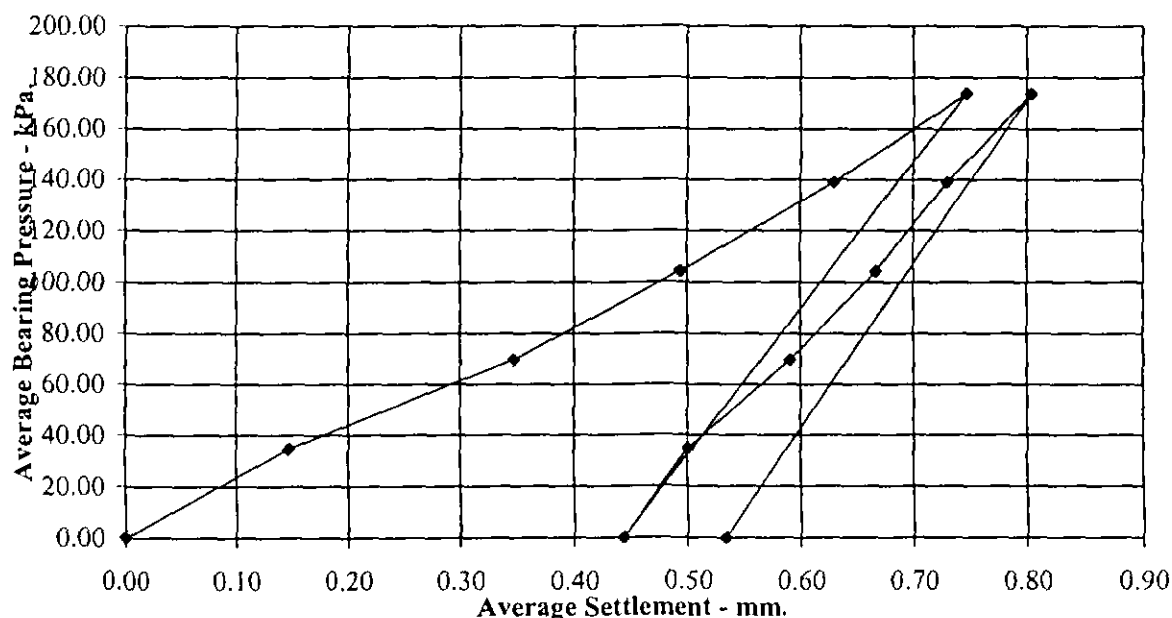
173.76

Maximum Deformation (mm):

0.80

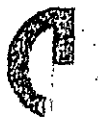
Description:

6F2



Compiled By	Date	Checked By	Date	Approved By	Date	Contract No.
						PSL06/1230
GOLDTHORPE COLLIERY						Client Ref.

APPENDIX D
Chemical Testing Results



RECEIVED 02 JUN 2006

Encia Consulting
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

ATTN: Matthew Cole

CERTIFICATE OF ANALYSIS

Date: 01 June, 2006
Our Reference: 06/08397/02/01
Your Reference:
Location: GLODTHORPE COLLIERY

A total of 10 samples was received for analysis on Friday, 19 May 2006 and completed on Thursday, 25 May 2006. Accredited laboratory tests are defined in the log sheet, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation. We are pleased to enclose our final report, it was a pleasure to be of service to you, and we look forward to our continuing association.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials- whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Signed

Diane Whittlestone
Customer Services

Jane Seymour
Customer Services

David O'Hare
Customer Services

Caroline Suttie
Customer Services

Valid if signed by any of the above signatories.

Compiled By

Paul Armitage



ALcontrol Geochem TEST SCHEDULE

JOB NUMBER : 06/8397/02

CLIENT : Encia Consulting

CONTACT : Matthew Cole

DATE OF RECEIPT : 19/05/06

LOCATION : GLODTHORPE COLLIERY

BATCH NUMBER : 1

CLIENT REF/CODE :

ORDER NUMBER : R004116

TURNAROUND : 5 days

Numeric values indicate
additional scheduling

* indicates test subcontracted

Sample Number	Sample Identity	P / V	Depth	Sample Type	UKAS Accredited ?		Metals (CP, 9 (S))	Boron Water Soluble (S)	Sulphate Total (S)	Sulphate Soluble Kone 2:1 (S)	pH (S)																		
					✓	✓																							
1	WSS 1	TUB	-	SOIL	X	X	X	X	X	X	X																		
2	WSS 2	TUB	-	SOIL	X	X	X	X	X	X	X																		
3	WSS 3	TUB	-	SOIL	X	X	X	X	X	X	X																		
4	WSS 4	TUB	-	SOIL	X	X	X	X	X	X	X																		
5	WSS 5	TUB	-	SOIL	X	X	X	X	X	X	X																		
6	WSS 6	TUB	-	SOIL	X	X	X	X	X	X	X																		
7	WSS 7	TUB	-	SOIL	X	X	X	X	X	X	X																		
8	WSS 8	TUB	-	SOIL	X	X	X	X	X	X	X																		
9	WSS 9	TUB	-	SOIL	X	X	X	X	X	X	X																		
10	WSS 10	TUB	-	SOIL	X	X	X	X	X	X	X																		
Total Number of Tests					10	10	10	10	10	10	10																		

Printed : 01/06/06 09:30:09

☒

- * ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: GLODTHORPE COLLIERY
Client Contact: Matthew Cole

All results expressed on a dry weight basis.

Page 4 of 10

ALcontrol Geochem Analytical Services

Table Of Results - Appendix

Job Number:

06/08397/02/01

Client:

Encia Consulting

Client Ref. No.:

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

NDP No Determination Possible

* Subcontracted test

NFD No Fibres Detected

» Result previously reported (Incremental reports only)

ISO 17025 accredited

M MCERTS Accredited

PFD Possible Fibres Detected

EC Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

[illegible]

^a Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.

APPENDIX

ALCONTROL GEOCHEM - MCERTS UPDATE (10th April 2006)

Annex A (normative)

Table 1 - Performance characteristics (metals and organometallics)	UKAS	MCERTS
Antimony	yes	yes
Arsenic	yes	yes
Barium	yes	yes
Beryllium	yes	yes
Boron (water soluble)	yes	yes
Cadmium	yes	yes
Cobalt	yes	yes
Copper	yes	yes
Chromium	yes	yes
Iron	yes	yes
Lead	yes	yes
Manganese	yes	yes
Mercury	yes	yes
Molybdenum	yes	yes
Nickel	yes	yes
Organolead compounds	no	no
Organotin compounds	no	no
Selenium	yes	yes
Thallium	yes	p
Vanadium	yes	yes
Zinc	yes	yes

Table 2 - Performance characteristics (inorganics)	UKAS	MCERTS
Easily liberated cyanide	yes	yes
Complex cyanide	yes	yes
pH	yes	yes
LOI	yes	yes
Sulphide	yes	p
Sulphate	yes	yes
Sulphur	yes	yes
Thiocyanate	yes	yes
Exchangeable Ammonium	yes	yes

Table 3 - Performance characteristics (organics)	UKAS	MCERTS
Benzene (GC- FID & GC-MS)	yes	yes
Benzo[a]pyrene (GC-MS)	yes	yes
Chlorobenzene	yes	yes
Chloromethane	yes	p
Chlorophenol (2-chlorophenol)	yes	yes
Chlorotoluene(2-chlorotoluene, 4-chlorotoluene)	yes	p
1,2-dichloroethane	yes	p
Dichloromethane	yes	p
"Dioxins"	no	no
Ethylbenzene	yes	p
"Furans"	no	no
Hexachlorobutadiene (SVOC)	yes	yes
"Hydrocarbons"	yes	yes
"Nitroaromatics"	yes	no
Pentachlorophenol	p	p
"Phenols" - Phenol by HPLC	yes	yes
"Phthalate esters"	p	p
"Polyaromatic hydrocarbons" by GC-MS	yes	yes, exc naphthalene
"Polychlorinated biphenyls" (Aroclors)	yes	yes
Tetrachloroethane (1,1,1,2)	yes	yes
Tetrachloroethene	yes	p
Tetrachloromethane (carbon tetrachloride)	yes	yes
Toluene (GC-FID)	yes	yes
Trichloroethane	yes	yes
Trichloroethene	yes	yes
Trichloromethane (chloroform)	yes	yes
Vinyl chloride	yes	yes
Xylene (GC-FID)	yes	yes

yes - accreditation awarded

p = pending - data meeting MCERTS criteria submitted to UKAS - awaiting certification

no = not being submitted in the near future

ALcontrol Geochem Analytical Services

Sample Descriptions

Job Number: 06/11639/02/01
Client: Encia Consulting
Client Ref : 81539

Grain sizes	
<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

[illegible]

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

☒

11

- * ISO 17025 accredited
- ^M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: GOLDTHORPE
Client Contact: Matthew Cole

All results expressed on a dry weight basis.

Date 13.07.2006

ALcontrol Geochem Analytical Services Table Of Results - Appendix

Job Number: 06/11639/02/01
Client: Encia Consulting
Client Ref. No.: 81539

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

NDP	No Determination Possible	*	Subcontracted test
NFD	No Fibres Detected	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
PFD	Possible Fibres Detected	EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

[illegible]

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

ALcontrol Geochem Analytical Services
Table Of Results - Appendix

Job Number: 06/11639/02/01
Client: Encia Consulting
Client Ref. No.: 81539

Summary of Coolbox temperatures

[illegible]

APPENDIX E
Encia Tier 1 Values

Generic Notes – Encia Geoenvironmental Investigations

4B. Contamination Laboratory Analysis & Interpretation (including WAC)

Waste Classification & WAC

In the context of waste soils generated by remediation and/or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics).
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds).
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds).

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

From 16th July 2005, landfill operators will require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**, and such waste must have been subjected to pre-treatment. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Encia typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc.

If off-site disposal of soils classified as hazardous waste were undertaken during redevelopment, then WAC analysis should be scheduled at an early stage in the remediation programme.

However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous. These contaminants can often be dealt with by alternative technologies (eg by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (eg WAC) is required.

Contamination Laboratory Analysis & Interpretation

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common Inorganic Contaminants

These include:

- metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc.
- semi-metals, most notably arsenic, selenium, and (water soluble) boron
- non-metals, most notably sulphur
- inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates.

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction.

Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to uv digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO₄), sulphides etc

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common Organic Contaminants

Petroleum hydrocarbons are a mixture of hydrocarbons produced from the distillation of crude oil. They include aliphatics (alkanes, alkenes and cycloalkanes), aromatics (single or multi benzene ringed compounds) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen.

Petroleum hydrocarbons can be grouped based on the carbon number range:-

GRO – Gasoline Range Organics (typically C₆ to C₁₀). Also referred to as PRO – Petroleum Range Organics

DRO – Diesel Range Organics (typically C₁₀ to C₂₈)

LRO – Lubricating Oil Range Organics (typically C₂₈ to C₄₀)

MRO – Mineral Oil Range Organics (typically C₁₈ to C₄₄)

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies.

Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C₅-C₄₀, whereas others define TPH as C₁₀-C₃₀.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C₄ to C₅ range) that will rapidly evaporate. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present.

Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present.

Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have more than two fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (Benzo(a)pyrene) and/or mobile in the environment (naphthalene).

Semi-Volatile Organic Compounds (SVOCs) include a variety of compounds, which as the names suggest have relatively low boiling points; however, VOC's are much more volatile than SVOC's. Examples of VOC's include benzene, chloroform and toluene; SVOC's include phenol, fluorene. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group attached to an aromatic ring (ie include a benzene ring and an -OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine

bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of Analysis (Organic Compounds)

TPH by GC-FID is a more refined analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C₁₀ to C₄₀ (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a breakdown of the TPH results into diesel range organics (**DRO**) and heavier lubricating oil range organics (**LRO**).

GRO (PRO) by GC-FID analysis detects the more volatile C₆-C₉ hydrocarbons (aliphatic and aromatic), including those organic compounds present in petrol.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID. Naphthalene (the lightest PAH) is also one of the 58 US EPA VOCs.

Speciated TPH by GC-FID provides a "banded" TPH, initially split into aromatic and aliphatic fractions and then further divided into fraction specific carbon bandings based upon behavioural characteristics.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK Guidance

The UK approach to the consideration of contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of so called source⇒pathway⇒target principles in order to establish the presence, or potential presence, of a pollutant linkage.

Encia adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Encia risk-derived screening values, or remedial targets.

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

The tier 1 risk assessment of **landfill gas** is undertaken through reference to the following documents:

- Approved Document C, Building Regulations 1991
- CIRIA Report 149, "Protecting Development from Methane", 1995

Further information is presented in Generic Note No. 5 – Hazardous Gas.

In March 2002 DEFRA and the Environment Agency published a series of technical research papers (R & D Publications CLR 7, 8, 9 and 10) introducing the UK approach to the assessment of risk to **human health** from land contamination. This methodology and approach represents current scientific knowledge and thinking. The overall methodology also included the Contaminated Land Exposure Model (CLEA) and some Soil Guideline Values (SGV's).

At the time of writing this report, SGV's were only available for a limited number of contaminants, the development of both the CLEA model and additional SGV's is ongoing. Where published, SGV's have been utilised as intervention values for the purpose of an initial Tier 1 assessment.

It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

With respect to the assessment of potential **phytotoxic effects** of contaminants, Encia refer to "The Soil Code" (MAFF, 1998) for copper and zinc. The CLEA SGV is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

"In general.....it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn".

Current Guidance derived by Encia

In the absence of UK SGVs for a number of "common" organic compounds, Encia have derived generic screening values for use as "Tier 1" values. These values have been derived using the RISC model, and taking account of UK policy decisions, Health Criteria Values and CLEA defaults.

PAH cannot be assessed as a single "total" value, as each individual PAH compound has different toxicity and mobility in the environment. Speciated analysis is required to determine the concentrations of the various compounds, most notably the key PAHs: Benzo(a)Pyrene (considered the most toxic of the PAHs); and Naphthalene (the most mobile and volatile of the PAHs).

Similarly, TPH cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG).

The TPHCWG have broken down "TPH" into thirteen representative constituent fractions or "EC Bandings". EC Bandings are based around Equivalent Carbon numbers and the TPHCWG have derived a series of physiochemical and toxicological parameters for each of the thirteen EC bandings. The methodology for the derivation of these banding-specific properties is outlined in the TPHCWG series volumes 1-4.

Encia have calculated a screening value for each of the thirteen constituent fractions. These fractions have then been considered in terms of GRO, DRO and LRO to provide simpler, conservative initial Tier 1 screening values.

Encia's derivation of Tier 1 values is based on a number of assumptions, most notably:

- a. The site's environmental setting, in terms of proximity to **Controlled Waters**, is not sensitive. It is not possible to derive generic Tier 1 values for waters, because distance and ground permeability are key factors, and both are extremely site-specific. Consequently, detailed quantitative risk assessment is required.

- b. Ground encountered during the site investigation will be isolated beneath a cover of "clean" soil. **Soil cover** in garden areas is "standard" remediation practice where brownfield sites are redeveloped for a residential end use. The majority of brownfield sites require a minimum 600mm soil cover. The CLEA model assumes that all pathways, other than inhalation of vapours, occur within 0.5m of ground level, consequently after placement of a 600mm thick soil cover, the only pathway of significance is vapour migration.

It should be noted that where the underlying ground is "clean", but includes undesirable elements (eg a significant proportion of demolition rubble, colliery spoil etc), a minimum 300mm thickness of soil cover is acceptable, in accordance with NHBC Standards, Chapter 9.2. However, before advocating a 300mm soil cover, consideration must be given to other potential pathways, most notably inhalation of dust, ingestion and dermal contact.

The ingestion and dermal contact pathways have a significant effect on the Tier 1 values for benzo(a)pyrene, and petroleum hydrocarbons (TPH) in the Diesel (C₁₀ to C₂₀) and Lubricating Oil (TPH C₂₁ to C₄₀) ranges.

- c. A conservative **Soil Organic Matter** of 1%.

(Note: $TOC = SOM \times 0.58$; and $FOC = TOC/100$).

Hydrocarbons tend to be "bind" with SOM, and therefore become less mobile. Consequently, Tier 1 values can be revised if the amount of organic matter within the soil exceeds 1%.

- d. Some determinands reach **residual saturation** before a vapour risk is predicted to occur. Prior to residual saturation, as the concentration of a contaminant in soil increases, so does the concentration of the same contaminant in the associated vapour phase. However, once saturation is reached, the concentration of contaminant in the vapour phase remains constant (for any given atmospheric conditions - temperature and pressure). Consequently, even if free product were encountered at depths >600mm, it would not pose a significant risk via the inhalation exposure pathway.

However, Encia recognise that it is unacceptable to leave free product in the ground and therefore arbitrary Tier 1 values have been ascribed to such contaminants. These values have been selected on the basis that they are below the limit of olfactory detection (ie at concentrations below Tier 1, odours are not readily identified).

Encia Tier 1 values

Contaminant	Tier 1 Value (mg/kg)	Comments/Notes
Benzene	0.5	
TPH <C ₁₀ Gasoline range organics (GRO)	0.5	Based on conservative assumption that all TPH<C ₁₀ is benzene. If concentrations >0.5 mg/kg are recorded, but no benzene is present, a Tier 1 value of 59 mg/kg could be adopted for the gasoline range or reference can be made to Refined Tier 1 Values for speciated TPH (see below).
Xylene	91	
Benzo(a)pyrene	39	Residual saturation reached at 39mg/kg. 39mg/kg selected as Tier 1 value although no inhalation risk identified at 600mm depth.
Naphthalene	41	
total PAH	41	The higher volatility of Naphthalene makes it the most problematic PAH in ground overlain by a soil cover. Consequently, Encia have adopted the Tier 1 value for Naphthalene (41mg/kg) as an initial Tier 1 screening value for total PAH, on the conservative assumption that all the PAH is Naphthalene.
TPH C ₁₀ - C ₂₀ Diesel range organics (DRO)	540	If DRO above tier 1 value and speciated fraction banding for all sources on site are available, refer to Refined Tier 1 Values for speciated TPH (see below).
TPH C ₂₁ - C ₄₀ Lubricating range organics (LRO)	5,000	Residual saturation reached for all fractions; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.

Refinement of Tier 1 values for TPH compounds is possible by considering speciated test results (see below).

Refined Tier 1 values (TPH Bands)

Contaminant	Refined Tier 1 values (mg/kg)	Comments/notes
Aliphatic C5-C6	120	
Aliphatic C6-C8	500	Residual saturation reached due to lower toxicity of aliphatic compounds (cf aromatics), therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 500 mg/kg is well below the limit of olfactory detection.
Aliphatic C8-C10	66	
Aliphatic C10-C12	1,000	Residual saturation reached; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 1,000 mg/kg is well below the limit of olfactory detection.
Aliphatic C12-C16	1,000	
Aliphatic C16-C21	1,000	
Aliphatic C21-C34	5,000	Residual saturation reached at 16mg/kg; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.
Aromatic C7-C8	59	
Aromatic C8-C10	100	
Aromatic C10-12	540	
Aromatic C12-16	1,000	Residual saturation reached; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 1,000 mg/kg is well below the limit of olfactory detection.
Aromatic C16-C21	1,000	
Aromatic C21-35	5,000	Residual saturation reached at 16mg/kg; therefore no inhalation risk at 600mm depth. Tier 1 value selected on the basis that a concentration of 5,000 mg/kg is well below the limit of olfactory detection.

UK physiochemical properties, environmental properties, receptor and pathway parameters assumed within the assessment are detailed in the table below.

RISC input parameters to reflect UK position and data source.

Parameter	Data Source
Chemicals of concern	- Individual chemical SGV and Tox reports
	- Environment Agency Publication - Review of the Fate and Transport of Selected Contaminants in the Soil Environment. Technical Report P5-079/TR1
	- TPH Criteria Working Group Vol 1-4
Surface soil and pathways selection	As 600mm cover assumed no direct ingestion of soil or dust, dermal contact or vegetable uptake and consumption. Inhalation pathway only.
Vapour Inhalation and pathways selection	Johnson and Ettinger model used as default in RISC model considering vapours from a contaminated soil. Default model acceptable as is also UK adopted model for inhalation
Determine receptor point concentration	
Indoor Air – Building parameters (residential house)	Environment Agency and Defra Publication CLR 10
	'Technical basis and algorithms', CLEA briefing notes
Cross-sect. area of basement = 40m ²	CLEA Briefing note 3
Volume of building = 196.6m ³	CLEA Briefing note 3
No. air changes per day = 12	CLEA Briefing note 3
Foundation thickness = 0.15m	CLEA Briefing note 3
Fraction of cracks = 0.001	CLEA Briefing note 3
Porosity of cracks = 0.25	CLEA Briefing note 3
Water content in cracks = 0	Assume 0 – no moisture restriction to vapour migration
Flow rate of soil gas into building = 0	CLEA Briefing note 3
Length of foundation perimeter = 34.4m	CLEA Briefing note 3
Depth of foundation = 0.15m	CLEA Briefing note 3
Pressure difference = 30g/cm ²	CLEA Briefing note 3
Permeability of soils = 1x10 ⁻⁹ cm ²	Assumed from model default
Lens - material above source	Scenario specific
Thickness: 'clean' cover in garden areas assumed = 600mm (cover depth)	
Porosity = 0.46	CLEA Briefing note 2 and CLR 10
Water content = 0.15	CLEA Briefing note 2 and CLR 10
Source data – data regarding material contamination located in	
Porosity of source material = 0.46	CLEA Briefing note 2 and CLR 10
Water content of source material = 0.15	CLEA Briefing note 2 and CLR 10
Fraction organic carbon = 0.01	CLR 10
Bulk density = 1.6	CLEA Briefing note 2 and CLR 10
Unsaturated zone – data regarding material surrounding source	
Distance to building from source or groundwater = 0.15	Scenario specific
Total porosity = 0.46	CLEA Briefing note 2 and CLR 10
Water content = 0.15	CLEA Briefing note 2 and CLR 10
Source concentration – maximum recorded site concentrations	Site Specific (assumed 100 for all single compounds and 10,000 for all TPH fractions)
Describe receptor	
Receptor and analysis type	
Deterministic analysis, one receptor of a child resident (RME)	CLR 10 default parameter for a residential development
Exposure Data	
Based on a female child of 0-6 years.	
Averaging time/lifetime = 6yrs	CLR10
Body weight = 14.5kg	CLR 10 Table 5.6
Exposure Frequency = 365days/yr	CLR 10
Exposure duration = 6yrs	CLR 10
Soil Ingestion rate = 100mg/day	CLR 10 Table 6.1
Total skin surface area = 6166cm ²	CLR 10 Table 5.8

Parameter	Data Source
Fraction skin exposed = 0.265	CLEA Briefing Note 1
Soil/skin adhesion factor = 0.1	CLEA Briefing Note 1 and SGV reports
Exposure frequency for veg uptake = 365days	CLR 10
Exposure duration for veg uptake = 6yrs	CLR 10
Root Veg ingestion rate = 67g/day	CLR 10 Table 6.3
Above ground veg ingestion rate = 34.3g/day	CLR 10 Table 6.3
Fraction of home grown veg = 0.28	CLR 10 Table 6.4
Fraction organic carbon in soil = 0.01	Site Specific
Exp. Frequency indoor air = 365 days	CLR 10
Exp. Duration = 6yrs	CLR 10
Lung retention factor = 1	Assumed
Inhalation rate = 0.43m ³ /hr	CLR 10 Table 5.9
Time indoors = 20.6hr/day	Sniffer Framework Table 10.3

Note: The information contained within the table above reflects all parameters within the RISC model that were amended to reflect current UK guidance and scenarios. The model summary is not included with this text but is available upon request.

Possible Action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

- Undertake further statistical analysis following the approach set out in Appendix A of CLR 7 in order to determine whether contaminant concentrations of inorganic contaminants within soil/fill actually present a risk (only applicable to assessing the risk to human health).
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
- Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis (as set out in Appendix A of CLR 7) the issue of the **averaging area** requires further consideration. CLR 7 suggests the averaging area should be representative of the receptors behaviour, such as a single garden or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Encia consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Encia gather and analyse sample results by fill type, and/or by former use in a given sub-area of the site, before undertaking statistical analysis; ie the averaging area is associated with the extent of a particular fill type, or an area affected by spillage/leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass; ie contamination would normally be more pervasive and significant in granular soils than cohesive soils.